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The Effect of Medical Education Upon Our Economic Future*

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MEDICAL education with its many ramifications is a continuing process from our premedical school days to the termination of the practice of medicine, and since it plays such an important rôle in our economy, I deem it expedient, particularly at this critical period, to discuss it quite frankly.

To realize the full significance of such a discussion we must admit that the American Medical Association, our parent organization, promulgates the iron-clad rules for our education, our ethics, and consequently our medical future, and for fear of being misunderstood, or by chance misquoted, let me emphasize with all the force at my command that I have but one and only one purpose in mind, and that is a sane survey of our educational problems with the sincere hope that it is not too late to awaken the doctors, especially in our Southland, to their responsibilities.

If we realize the seriousness of our educational trend I am sure that we will agree that a fearless leadership must be provided that can and will assist the American Medical Association in appreciating our many problems, especially as regards the South. It must be recognized that we represent largely a rural people whose finances are not comparable to those of the great industrial areas; consequently rules and regulations pertaining to our education and practice must be studied and altered to meet the need. If this leadership is to be

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developed and play a rôle in safeguarding the patient and the physician, it means that every medical organization, regardless of its highly specialized function, must assume a responsibility by boldly asserting itself in correcting many of the existing evils, and too, every doctor of medicine, regardless of his type of practice, or location, must lay aside the rôle of greed and selfishness and wholeheartedly support those of our profession who are making a personal sacrifice to protect you and me and the American way of life.

With the rapidly changing world panorama, especially in the last decade or so, there cannot be one among us who is so naive as to believe that we as doctors could continue serenely on our way without some adjustments to meet the problems of the day. Since truth will prevail, why not admit that we as individuals have been so self-centered and selfish that important economic problems vitally affecting us have been left largely to a few leaders in medicine, whose only reward has been self satisfaction in trying to render a service, notwithstanding the criticism from a segment of our profession, who cry politics, which, after all, is only a disguise to avoid rendering a service or by chance incur a small expense.

Down through the years the American Medical Association and in fact all medical organizations have been ultraconservative in all matters except perhaps scientific medicine. Economic problems for the most part have been overlooked, and today we are being manhandled by forces that are ruthless and have neither the doctor's nor the patient's welfare at heart.

Our problems today are largely chargeable to lack of progressive leadership on the part of our parent organization but after all, who is the American Medical Association? It is you and I. Had we but exercised our prerogative as members of this democratic organization, there would be justification for the criticism that is being thrown at us daily by governmental agencies, a misinformed press and so forth. Today, however, with such men as Elmer Henderson and George Lull at the helm of the A.M.A., we have a dynamic force cognizant of our problem, and they are putting up a gallant fight for you, for the patient, and for America; but to reach their goal they need the help of every doctor.

In admitting our mistakes, be they of omission or of commission, we should remember that ours are only comparable to those of other professions, such as law, engineering, the ministry, and so on; but for the very reason that we are dealing with human life, we are more vulnerable, because sickness has no respect for person or station in life. For this reason the masses are susceptible to the politician's promise of protection from the cradle to the grave.

If the American public could only appreciate the conditions that exist in New Zealand, Australia, and Britain, as a result of this alluring medical practice bait as a driving wedge for socialism, I am sure they would oppose any such program for America. In fact, from current news, it seems that this politician's Utopian dream has recently become a horrible nightmare. However, the turn of events in these countries should not affect us because we are still faced with serious problems in our educational program that must be corrected regardless of the political trend, and these corrections must be made by us and not by the Federal Government.

If we are to maintain the confidence of the American public, a comprehensive program must be adopted with active support of every medical organization and every doctor; for the time has long since passed when matters that so vitally affect our professional existence and the welfare of the public can be ignored and left to a few faithful workers who are desperately trying to save us from the obvious pitfalls that lie ahead. But if any such program is to be effective it must first consider the patient's welfare, and this means that serious thought must be given to those problems that vitally affect the economic stability of both patient and taxpayer.

Medical education, which obviously includes dentistry, pharmacy, nursing and hospitals, must be studied in evaluating this economic problem. Due to the tremendous strides in all lines of medical work during the past decade or so our whole economic system has been disturbed by reason of a mounting cost to the patient. In fact, the cost has already reached such proportions that the average wage earner cannot meet the obligations incident to sickness except perhaps by prepayment hospital and sickness insurance.

Our medical colleges through the direction of the American Medical Association, Council on Medical Education plus the ruling of the Association of American Medical Colleges, which is a closed union, have steadily increased the requirements for graduation with the result that most of our boys upon completion of college work are pseudoscientists instead of well trained practitioners of medicine. As a result of this pseudoscientific program the graduate today is largely dependent upon one or more years as a resident before he is competent to enter the practice of medicine. Then, in most instances his patient must be hospitalized because he has been taught to depend largely upon hospital facilities for both diagnosis and treatment.

After having spent four years in college, four years in a medical school plus two or three years in a hospital is it any great wonder that we are unable to supply doctors for our rural areas or for them

to condescend to answer many night calls: this boy is a specialist due to his training in both school and hospital, and has every right to consider himself as such when charging for service rendered. In fact, this specialty training has attained such major proportions in our educational program that far too many hospitals are being recognized for residency training with the result that many of these boys are poorly trained, having but actually done the "scut" work for staff members who are reaping the financial rewards. All this has to do with the increasing cost of medical care and must be reckoned with in evaluating our present day economic status.

In this connection, it is quite significant of our lack of foresightedness that for the past few decades during which time our population has increased at least 30 millions, according to the latest census report, there has been no comparable increase in the number of graduates of medical schools. Also, we have not reckoned with the situation created by the Veterans Administration Hospital Service and the augmented peacetime military forces, which are clamoring for and obtaining many of the recent graduates. There is a need for better distribution of our doctors and for more graduates each year if we are to meet the demand for more general practitioners and at the same time offset the inroads that are being made by both osteopath and the chiropractor.

It might be of interest to state here that in the United States there are 78 medical schools. Of this number, 43 are private schools without direct federal or state tax aid; however, most of them are receiving federal subsidy in some form. Six are basic science schools with only two years of medicine. The total number of graduates for 1948-1949 was 5,094, while for the year 1905-1906 there were 5,606 graduated; and these figures include those who graduated from the two year basic science schools. It is estimated that more than 3,500 doctors die each year, a thousand or more are absorbed by the military services or the Veterans Administration, and this fails to take into account the many who retire each year or give up the practice of medicine for some more lucrative interests.

In this connection we must reckon with the teaching centers which are providing one intern or resident for every six or eight patients. Obviously, this practice, which is questionable from the standpoint of training, due to the excessive number, deprives many well equipped hospitals of the service of either intern or resident. Many of these boys are accepted as assistant residents for one or two years with no hope of ever advancing further, but regardless of this inadequate training they expect, rightfully, to practice as specialists and charge accordingly.

To meet the shortage of doctors, especially in our rural areas, it has been suggested by medical educators that the erection of small hospitals that are to be a unit of a teaching institution will solve our problems by inviting the trained doctor to seek a country practice. This is, I am afraid, but an invitation in most instances for the poorly trained surgeon, who by reason of these advantages will further commercialize our profession, and attempt work that he is not qualified to perform. With our present efficient modes of transportation, and splendid roads, no area is isolated from some well staffed hospital.

Dentistry is a highly technical field that requires practice to make perfect; therefore, I can find no fault in the four year requirement. However, it would seem that through their organizations they could work more closely with the medical profession in attempting to correct some of the obvious evils, because they are a part of the medical fraternity, and are susceptible to the same threat of regimentation.

In the field of pharmacy we have neglected our responsibility by allowing a few Ph.D.'s who are full time, to increase the requirements to four years of training. It is obvious to every thinking physician that the large drug concerns are compounding our prescriptions. They are doing the experimental work with drugs and through their field agents are largely directing the practice of medicine. So why penalize these poor boys by requiring four years in pharmacy? All this reflects upon the patient's economy by increasing the cost of medicine and is further bait for the "fair dealers" who are clamoring for governmental control.

Another evidence of our lack of leadership lies in the field of nursing. Here we have been content to allow this segment of our medical education program to be almost entirely dominated by hospital administrators and by a few supereducated nurses. In fact the scholastic requirements and classroom work have been so augmented that the pupil nurse can no longer do effectively the sickroom duties because time is not available for this practical training.

It is interesting to note the recent appearance of a book, "Nursing for the Public," by Esther L. Brown, of the Russell Sage Foundation. Strange as it may seem, this distinguished lady is neither an M.D. nor a graduate nurse. The nursing schools are rapidly developing, if not already accomplished, a philosophy of nursing that makes the nurse a pseudoscientific nurse, so much so in fact that many are either prescribing for patients or advising the physician. There is an urgent need for practical nurses who are trained in the

simple art of caring for sick patients and this can be done without previous college work and with only two years of training.

The fact that hospitals are entering the field of practice of medicine is one of the most serious problems confronting our profession today. It must be admitted that our medical schools have been in years gone by the greatest offenders, but in more recent time the Veterans Administration has taken the lead by reason of more hospitals, easy access to the taxpayers' money, and the fact that the lawmakers in both state and nation seem to think that the veterans' vote is the controlling factor in guaranteeing a return to office. All this is without too much regard for the remaining 130,000,000 people who live in the United States.

It is indeed inconceivable to me that our great centers of learning, the medical colleges, could have been persuaded to participate in the Veterans Hospital Program which obviously is not best for America, and this necessarily means the patient, the physician, and the taxpayer, unless perhaps many of these institutions are controlled by administrative heads who are not physicians and are perhaps being advised by faculty members who fail to appreciate the problems incident to private practice and are not in sympathy with the present concept of medicine as it is now being practiced in America.

The alluring \$50 consultation bait that is being paid many physicians today can in many instances be referred to as hush or good will money, and it is evident that herein lies the reason for the medical profession's hands off policy.

It must be obvious to every fair thinking American that boys with *service connected disability* are entitled to the best our government and our profession can give them, but in considering this question we must realize that these unfortunate boys are greatly in the minority. In fact, about 20 per cent of those being treated in our Veterans Hospitals fall in this category, while 80 per cent of those admitted are for nonservice connected disability, and I am advised authoritatively that men are being admitted without regard for physical disability or financial status; in fact, they are only asked to sign on the dotted line.

Notwithstanding the staggering cost in building, which varies from \$20,000 to \$50,000 per bed for these patients, other such hospitals are being erected with only a passive protest from our medical organizations. In fact, today there are 130 Veterans Administration Hospitals and 44 others are in the process of being constructed at an approved cost of more than a billion dollars. A careful survey will, I am sure, reveal that many of these patients

are not hospital cases and that the present hospitals, according to available statistics, are not occupied to normal capacity, nor are the patients in many of these institutions receiving a service that is comparable to the service offered in most of our teaching or private hospitals.

Today many of our young physicians are seeking employment with the Veterans Administration, not for the high type of training offered, but because of the promise of a life of ease and a retirement after 20 years of service. Some undoubtedly are afraid of complete regimentation and are seeking this protection in the hope of immunity when and if the fatal day arrives; however, this promise carries no guarantee so far as I can ascertain; and if the day comes, these boys will, I am afraid, be disillusioned regarding their status. In this connection, I am informed by the Director of Veteran Affairs that more applications are being received than are needed, except in the field of radiology, pathology, and anesthesiology. Our American boys seem no longer interested in these branches of medicine, realizing as they do that it means a life in medicine that for the most part is being directed by a nonprofessional hospital administrator.

From the vantage point today one must conclude, therefore, that all this fits into the picture of regimentation, and this is more forcibly brought to our minds when we hear unauthorized rumors that soon the families of these veterans will be included in this program. I quote from a recent speech of the Hon. James F. Byrnes, former Secretary of State: "Beware of those who promise something which does not belong to them and which can only be given to you at your own expense."

The fact that many hospitals entered the field of medical practice (which is contrary to law in many states) can be charged to existing economic conditions, especially during the lean years. Another impetus to the practice of medicine by hospitals was the standardization program of the American College of Surgeons and the American Medical Association, which required, among other things, exact records, full time pathologists, radiologists, and so on; and while this has unquestionably increased the type of hospital service, yet it has left the physicians in these fields to the mercy of the hospital administrator who in too many instances gloats over the enormous income to the hospital.

If this practice is permitted to continue, those of us in other branches of medicine will soon be reporting to the lay administrator; for today in many of the larger hospitals, such as Barnes of St. Louis, have adopted a policy whereby the physician works for the hospital on a salary basis.

The seriousness of this situation was first discussed by a group at one of the annual meetings of the Southern Medical Association, and a committee was appointed to bring the matter to the attention of other organized medical groups. Following this, a committee was appointed by the American Medical Association last year, and its report was favorably acted upon at the meeting in Atlantic City. In this report the question of hospitals practicing medicine was condemned, but due to the complexity of the hospital question, such as clinics, medical colleges, etc., it was recommended that the problem should be handled through the state and county medical societies. It was suggested that if state societies would endorse this policy and ask each component society to appoint a committee on physician-hospital relations, it might help to clarify this evil. To this end, several states, including Massachusetts, Pennsylvania, and West Virginia, have through their state societies endorsed the plan and appointed committees on hospital-physician relations with the hope that this controversy can be settled on a local level.

But if this effort fails, then the American Medical Association must promulgate rules that are non-compromising and refuse to recognize for intern and residency training the hospitals that persist in this practice.

This comprehensive program of organized medicine must provide a plan that will insure good medical treatment for *all the people* at a cost that is *commensurate with their ability to pay*: and to accomplish this we must first alter our present medical education program so that a sufficient number of practitioners will be available. In this connection earnest study and thought should be given to the matter of the number of graduates each year, for I am informed from the office of the Secretary of Defense that the Armed Forces are short more than one thousand doctors, with the probability that many who were trained under the government subsidy plan will be discharged within a few months.

With the idea of providing more general practitioners, I suggest a minimum premedical course of three years along a basic educational line with less science work, since it is not only evident but at times embarrassing to find recent graduates in medicine unable to write or speak correctly, not to mention the total lack of knowledge pertaining to history, literature, or even the simplest economic problems of life; and in this connection, I think you will agree that the college science courses offer little in the medical school program or in the actual practice of medicine. The boy who aspires to become a physician needs a broad well rounded education to the end that he can become a leader in community affairs.

Upon completing satisfactorily one year in medicine the student

should be awarded an A.B. degree by his college, and after graduating in medicine and *completing one year of approved internship* the degree of M.D. should be conferred upon him and he should then be licensed as a doctor of medicine rather than being certified as a competent physician and surgeon, as is now done by most states.

Since it is obvious that specialty training has seriously affected our economy by increasing the cost of medical care, it would seem timely that our practicing profession exercise some control over this type of training, instead of leaving this vital matter with full time professors who in most instances have never practiced medicine for a living, and consequently know little of the problems that confront the doctor who must meet competition and at the same time maintain a high ethical standard and take care of the monthly payroll.

For the boy who aspires to become a specialist, why not require three years of general practice and one year of basic science training before he is permitted to begin a residency training. Upon completing this training, which should be for a minimum of three years in an A.M.A. approved hospital or two years in an approved hospital and two years under a recognized preceptor, he can then be licensed as a specialist by a state specialty board. By creating specialty boards in the various states much of the confusion and misunderstanding regarding our national boards would be eliminated. However, this does not mean the elimination of our national boards because they can render a real service of passing upon the qualifications of men who aspire to be teachers, directors of research, and so forth. And in this connection, it would seem expedient to consolidate many if not all of the national surgical boards into one body, thereby eliminating much duplication of effort.

Since the resident staff are doing much of the routine work for the staff members, thereby relieving them of the necessity of employing additional help, why not pay these boys a living wage during this training period, for many of them are married and have incurred a family responsibility plus an indebtedness for their schooling.

If we are to provide more general practitioners of medicine we must graduate 1000 to 1500 more students each year and adopt a plan that is approved as ethical which will provide a larger income for the general practitioner. This might be handled equitably by group practice that will include the general doctor and, after all, a group working together can assure the patient a superior type of medical service without an extra fee for every individual, who by chance sees the patient professionally. Groups such as these to suc-

ceed must of necessity adhere to ethical standards or be ostracized by organized medicine.

The very thing that is driving practically all the physicians into specialty work is the economic advantage offered men with a few years' training, be it good or mediocre. The too wide differential between the income of the general doctor and that of the specialist is one of the causes of our economic upset in medicine, and if this inequality can be adequately adjusted, there is every reason to believe that many of our problems will be solved.

The plight of the medical colleges, especially those without state aid, is a challenge to our great profession; and if we are to forestall federal control of this branch of education, vigorous steps must be taken with our full support to maintain all medical colleges, *at least on a State level*. Our medical schools of the South cannot compete with the highly endowed colleges of the East, and if they survive every doctor must realize their plight and individually become a committee of one to preach the necessity for state tax aid, for further Federal Government subsidy will eventually lead to control with all of its undesirable implications.

In trying to reach a fair and equitable decision regarding the Veterans Hospital set-up we must consider the Hoover Commission report on governmental hospitals because here it is conclusively shown that there is duplication of hospital service in the same area, which is unnecessary and costly. There are six such hospitals in New Orleans, while in greater New York this report shows eleven with a capacity of approximately 8,000 beds and an average occupancy of about 5,000. To stress further the waste of money and medical manpower, we are informed that there is one full time doctor for each nine patients. A consolidation of these hospitals that now represent various branches of the government would certainly seem feasible and economical.

If for political reasons, the nonservice connected disabled soldier must be protected, then why not give him this protection under some non-profit insurance plan such as the Blue Cross Hospital Service, together with medical coverage under the Blue Shield, but on a statewide basis rather than on a national basis, with reciprocal provision between states? To a man with dependents, whose income is \$3,500 per annum or less, and to the single veteran who earns \$2,000 or less, give this protection with a free choice of physician and hospital. This plan would eliminate a large segment of alleged loafers in our present Veterans Hospitals because of a provision that limits the number of hospital days each year. Then by the adoption of a fee schedule acceptable to both hospitals and doctors,

millions of dollars each year can be saved. It is my firm belief that if every post of the American Legion could be made acquainted with the facts pertaining to the enormous cost and the waste of the taxpayers' money, as well as the impetus to socialism, the Veterans Administration is providing, they would show their real Americanism by condemning any such program.

Since we are a hospital minded nation, these saved millions could and should be expended in a subsidized hospital program, for when we consider the shortage of hospital beds today, the small amount provided in the Hill-Burton bill is too insignificant to provide any real relief. The government is willing to spend billions for the hospitalization of 20,000,000 veterans, most of whom have nonservice connected disability but has only suggested a paltry \$150,000,000 for the remaining 130,000,000 of our citizens, notwithstanding the fact that millions of these men and women rendered a real service during the trying days of war and in most instances this service was rendered without a draft and without a word of protest. The "New Deal" philosophy has so increased the tax load that individuals, estates, or communities can no longer meet the excessive cost incident to hospital construction. Therefore, until a sufficient number of beds is provided to care adequately for our people, we must receive federal aid. However, this aid should be allocated to states in keeping with their needs and without government control.

I reiterate that for the service connected disabled soldier the best that both the Government and the physician can give will meet with the approval of every fairminded citizen, but to treat adequately this type of soldier a comparatively few institutions are needed, and these should be the very best and strategically located. The remaining hospitals that are now in operation or in the process of construction, should be given to the various states with the stipulation that they must be operated as state institutions for tubercular or mentally ill patients to replace the antiquated fire trap buildings that are now in use, or under state direction, be turned over to the cities or counties to be operated as general hospitals. The Federal Government should maintain custodial interest which could be exercised in the event these buildings were used for other than the treatment of the sick. Instead of building other Veterans Hospitals that are unnecessary, why not through the states and *purely on a state level* transfer the now appropriated money to the medical colleges, private and/or state owned, with the idea of meeting their present deficit? By the adoption of some such distribution of both veterans hospitals and approved construction money, many of our problems could be solved without additional tax funds. When this

is done, further federal aid must be discontinued unless we are inviting complete federal control.

Due to our mad rush for practice and prestige, we have forgotten the boys who aspire to the fields of pathology, radiology and anesthesiology and have left them to the tender mercies of the hospitals. In fact, this has reached a point where we are largely dependent upon the European trained men to fill many of these positions, and in due fairness, may I say they are doing a splendid job. They are energetic and competent teachers. Therefore, it would seem fair to show our appreciation of their skill and helpfulness to the American profession by changing our state medical laws so they can be licensed in their specialty work. This can in no way jeopardize the practice of medicine but will afford these men an opportunity to become members of our medical organizations, and I am sure they will contribute a great deal toward a higher type of medical knowledge.

We must remember that the time will come when we can no longer obtain the services of these highly trained specialists who are now working for hospitals; therefore, it is our responsibility to effect a plan whereby these trained men can be regarded as consultants and not as mere technicians to the end that more of our students will become interested in these branches of medicine, thereby providing a further safeguard against hospitals practicing medicine.

For these men I would suggest that they be in charge of their respective services and that the patients be charged for professional services rendered and the bill be submitted from the doctor who performs this service. It is immaterial who collects for this service so long as the patients know to whom the fee is being paid. The financial arrangements between the hospital and the physician can be determined upon some equitable percentage basis which will safeguard the hospital and restore to the doctor his rightful place in the medical profession.

In conclusion, I urge that every individual doctor become a committee of one to preach Americanism and that every medical organization working with the American Medical Association study our many problems intelligently and help to develop a fearless leadership that can direct us in combating the evils that so vitally affect our economic future.

INFECTIONS OF THE BRAIN FOLLOWING PENETRATING WOUNDS

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THIS paper is a review of the bacteriologic studies of infections that occurred in 276 penetrating wounds of the brain. These observations were made on craniocerebral wounds in an Army General Hospital designated a neurosurgical center from June 6, 1944, to June 23, 1945. The studies were carried out with the help and encouragement of Colonel R. Glen Spurling, neurosurgical consultant for the European Theater of Operations.*

In the early part of World War II the attention of surgeons had been focused on the bacteriology of wound sepsis and the new armamentaria of sulfa compounds and penicillin. Much was known about the selective action of the antibiotics against a variety of organisms but their use in the war proved conclusively their lack of effectiveness against certain groups of organisms. Inadequate therapy with both penicillin and sulfadiazine in any of the patients of this group prior to admission was rarely seen. Throughout the chain of evacuation intensive chemotherapy was routinely used.

In the first few weeks after patients began to be admitted to this hospital, Major Arthur D. Ecker and one of us (L.H.S.) recognized the poor response of gram negative infections of the meninges to penicillin and the sulfa compounds. Efforts to combat these organisms with massive doses of urea in conjunction with sulfa and penicillin in the earlier cases of this series has been reported by Ecker.

The laboratory section devoted much time to the work of bacteriologic identification. When the identity of an organism was in doubt the 1st Medical Laboratory bacteriologic section gave us most cooperative help. The acquisition of typing sera improved the accuracy of identifying *Klebsiellae* A and B and differentiating these organisms from *Aerobacter aerogenes*. During the period of this study every effort was made to insure accurate bacteriologic identification.

The surgical technics outlined and carried out by neurologic surgeons as advocated by Dr. Cushing and others in the last war have

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varied little with time and experience. The necessity for wide exposure of the cerebral defect, the meticulous debridement of the missile tract, the careful removal of all depressed bone fragments and foreign bodies that do not lie in positions where removal would endanger life or seriously injure function are still surgical axioms. Tight closure of the dura and scalp is of paramount importance. The tripod extensions to obtain relaxation for scalp closure and releasing incisions have been discarded, and marginal flap rotation substituted as a better method of accommodating for loss of scalp tissue. The relative harmlessness of small metallic foreign bodies and the importance of removing accessible large foreign bodies have again been confirmed in the experience of this war. The use of electrosurgery, fibrin foam, and thrombin has materially reduced the labor of hemostasis in the toilet of brain wounds. These advances in technic have been discussed in various other papers and need no further elaboration.

Despite the triage and transportation facilities that moved the wounded from the care of trained surgical teams in evacuation and field hospitals organized for special care of craniocerebral wounds, slow evacuation occurred at times. This was particularly true when weather conditions were poor, or when the urgency of battle required all available air transport for supply purposes. As a result, patients were frequently received in varying states of exhaustion at this neurosurgical center, and for this reason primary consideration was given to supportive therapy. Patients who had not had a primary debridement or who showed evidence of increased intracranial pressure were considered as emergencies.

On admission to the hospital 160,000 units of penicillin and 8 grams of sulfadiazine were administered daily for 72 hours routinely while the necessity for further surgical therapy was being evaluated. Chemotherapy was continued routinely for 72 hours after intracranial surgical procedures, and usually for 10 days after any operation in which organisms were cultured from the brain substance.

Blood deficiencies were evaluated and replacement made with citrated bank blood. Rapid mobilization was practiced with all suitable cases. Hemiplegic patients were mobilized with the help of ward attendants. X-ray studies were done in the first 24 hours after admission. Stereoscopic lateral and anteroposterior studies were made routinely. Where indicated, special views were taken to demonstrate pathology. Stereoscopic views of the optic foramina were particularly helpful in evaluating lesions of the anterior fossa and the accessory nasal sinuses.

All cases were operated in which retained and accessible bone fragments were present. One hundred and four patients had been debrided in forward hospitals. Eighteen had primary debridements at this hospital. If the superficial scalp wound had broken down after the initial debridement and closure, the wound was converted into a healed wound by secondary suture before any attempt was made to attack the underlying pathology. Seven to 12 days following secondary closure, residual debris and bone fragments were removed. Large scalp flaps were often used for the procedure of secondary debridement rather than reentry through the initial wound provided an adequate blood supply to the proposed flap could be preserved. When necessary, enough additional bone was removed to permit adequate inspection of the missile tract. All necrotic brain was sucked away. Smears for immediate study and cultures were taken at various levels and recorded. Spinal drainage was utilized to reduce intracranial pressure and facilitate exploration of the cerebral defect.* Unfavorable reaction to spinal drainage was not seen. The cavity was explored with instruments and, as suggested by Dr. Cushing in his writings of the last war, digital palpation was found to be the best method of locating residual bone fragments in the scar of the missile tract.

An attempt was made to correlate the amount of capsule formation or scarring along the missile tract with types of organisms and the length of time between injury and secondary debridement. The thickness of the membrane seemed to be greater in the presence of infection but was more related to the length of time between wounding and secondary debridement. Widespread cerebritis and edema with no capsule formation were found in three of the cases with gram negative bacillary infections associated with gas formation in the cerebral substance. The infection in the cerebral tissue did not have a limiting capsule in the five patients who died and were too ill to tolerate surgery (Table 1).

TABLE I

Fatal Cerebral and Meningeal Infections without Secondary Debridement

R.C.F.....	Meningeal cultures
	Friedlander's bacillus
	Gamma streptococcus
	Staphylococcus aureus
J.J.....	Paracolon bacillus
	Atypical Klebsiellae pneumoniae
E.V.....	Klebsiellae pneumoniae
M.C.P.....	Friedlander's bacillus
I.O.K.....	Klebsiellae pneumoniae, Type A

*J. E. A. O'Connell.

In the 122 surgical cases all accessible scar, metallic foreign bodies, necrotic brain substance and bone chips were removed. Occasionally bits of cloth, helmet lining and collections of hair which were not radiopaque were found. Large metallic foreign bodies were removed when necessary by making a new opening in the cranial vault over the location of the missile. One abscess and two small hematomas were found at the site of such missiles.

One hundred thousand units of penicillin, either as a dry powder or dissolved in from 2 to 4 c.c. of saline were placed in the cerebral defect on completion of debridement. Sulfadiazine was not used locally. If the ventricular system was opened during the debridement, 20,000 units of penicillin were administered three times a day intraspinally until the bacterial cultures could be evaluated. This therapy was continued if meningitis developed even when proved to be due to a penicillin resistant organism.

Fifty-three penetrating wounds of the cranium had proved bacterial contamination of the missile tract (Table 6). Of this number 48 were operated; 5 patients were in extremis and unable to tolerate surgery (Table 1). One patient had two abscesses (Case 3). Thirty-six of the 122 patients who were debrided showed encapsulated collections of pus or necrotic brain which were sterile, but microscopically showed white blood cells in concentration. These cases were classified also as abscesses, making a total of 85 surgically treated brain abscesses. The remaining 37 cases demonstrated remarkably clean missile tracts and showed poorly organized scar tissue formation around the retained bone and metallic fragments. The dura was made water-tight, and when necessary a pericranial graft was used for dural repair. The scalp was closed without tension by means of adequate mobilization in all but two cases. These were treated by open drainage using the technic of Dr. Joseph E. J. King.

The first case is cited to illustrate the presence of infection encountered in a patient in spite of adequate debridement in a forward hospital. Abscesses were encountered in the absence of bone chips in 6 cases (fig. 1).

CASE 1. J. P. was wounded in action by a high explosive shell fragment entering the parieto-occipital area on Feb. 2, 1945, in Germany. A craniotomy and debridement of depressed bone and injured brain, with dural closure utilizing a pericranial graft and scalp suture without tension was done on the same day in an evacuation hospital. Two weeks later (February 17) he was admitted to this general hospital. The record stated that he had developed immediate partial blindness at the time of wounding. He was irrational on admission. The sutures had not been removed from the wound, but the wound was healed and in good condition. A cerebral fungus was apparently

elevating his scalp by bulging through the cranial defect. Both periorbital areas were ecchymotic. The fundi showed many hemorrhages and a measurable choking of 3 diopters was present bilaterally. General physical examination and the remainder of neurologic observations were normal. X-rays revealed no evidence of residual bone fragments or metallic foreign bodies.



Case 1. Photograph demonstrates sub-galeal cerebral fungus elevating the scalp. Post-operative photograph shows healed incision.

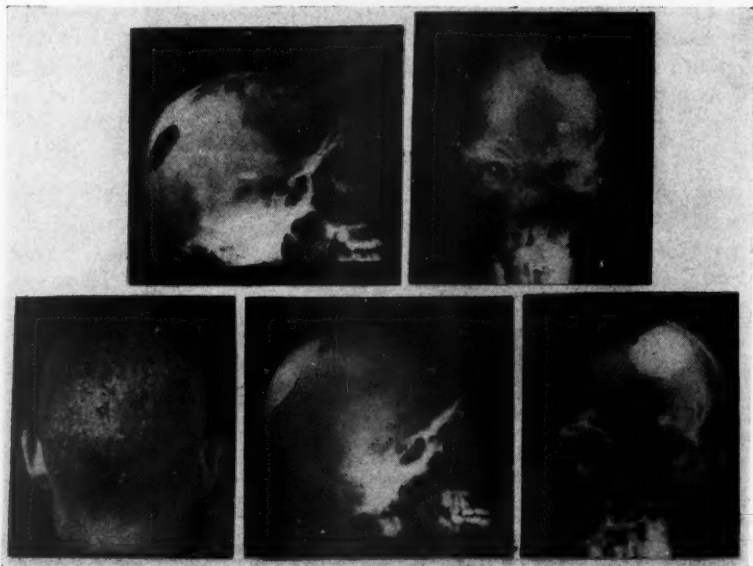
Operation, February 20: A large scalp flap was elevated with the healed wound near its center. Necrotic brain had herniated through the cranial defect pushing aside the pericranial graft that had been used for dural closure. Smears of this necrotic brain revealed no organisms but abundant leukocytes were observed. The bony opening was enlarged and the necrotic fungus was sucked away. A pocket containing 15 c.c. of greenish pus was encountered 3 centimeters beneath the dura. Smears of this pus again failed to demonstrate organisms. The wall of this pocket was thin and was resected. One hundred thousand units of penicillin in saline were placed in the cavity. The dura was again closed with a pericranial graft. The galea and skin were closed with interrupted sutures of fine silk.

Postoperative course: Cultures revealed a gram positive staphylococcus. Recovery was rapid and the patient was ambulatory in six days. The homonymous hemianopsia was unchanged in the short time that he was observed before transfer to the United States. Papilledema subsided rapidly. Penicillin and sulfadiazine was administered for 10 days postoperatively.

Abscesses were most frequently encountered around clusters of bone chips thus giving a cluster of chips a somewhat ominous char-

acter. The second case illustrated the typical course in such an instance (fig. 2).

CASE 2. J. J. F. was wounded by a high explosive shell fragment which struck the right posterior parietal area on Nov. 10, 1944. At the time of his admission to an evacuation hospital on the same day he had regained consciousness. He showed a left hemiplegia with greatest involvement in the lower extremity. Under sodium pentothal anesthesia, debridement of the injured brain and depressed bone fragments was done. A water-tight dural closure was accomplished by using a graft of pericranium. His postoperative course was uneventful and he was transferred to this hospital on November 23.



Case 2. Roentgenograms taken on admission demonstrate residual bone fragments after primary debridement. Postoperative complete debridement with tantalum plate in situ.

On admission the patient was quite apprehensive. The scalp wound in the right parietal area was healed; a 3 by 4 centimeter bony defect was present and pulsated freely. A spastic left hemiplegia with greater involvement of the lower extremity was observed. The tendon reflexes on the left were exaggerated and ankle clonus could be elicited. The left abdominal reflexes were absent and the plantar response was upward on this side. Cortical sensibility was impaired on the left side of the body. X-rays demonstrated four large bone fragments in the right parietal lobe. Anterior to this and in the region of the anterior horn of the lateral ventricle lay a 1 by 0.5 centimeter metallic foreign body. This foreign body lay 14 centimeters from the point of entry.

Operation: Under intratracheal oxygen-ether, a scalp flap was elevated exposing the cranial defect. The pericranial graft used for dural closure appeared to be in good condition. One side of the graft was detached. The

brain beneath was quite tense. A lumbar puncture was done and sufficient fluid removed to relax the brain. After this procedure the missile tract was easily entered. It contained necrotic brain and serosanguineous fluid. The four large bone chips observed lay in a pocket of serosanguineous pus. Fifteen smaller fragments which had not been visualized by the preoperative roentgenograms were also removed. The fibrin wall of the tract was debrided. Smears of the fluid and necrotic brain showed many leukocytes. No attempt was made to remove the metallic foreign body because of its distant location and the possibility of spreading infection to the ventricle. The dural graft was sutured in place along its detached border. One hundred thousand units of penicillin were placed in the cerebral defect. A tantalum plate was fashioned and secured over the bony defect and the galea and skin were closed in layers with silk. The practice of inserting plates at the time of secondary debridement was used only a few times and abandoned as it interfered with follow-up x-rays and introduced a factor that could conceivably interfere with wound healing or promote continued infection.

Postoperative course: Cultures showed a non-hemolytic staphylococcus albus had been present in the cerebral wound. Penicillin and sulfa therapy was continued an additional week. The patient was up on the day following surgery and his convalescence was uneventful. The hemiplegia improved considerably before evacuation to the United States.

The following case illustrates the possibility of more than one abscess connected with cerebral trauma.

CASE 3. N. C. P. sustained a perforating shell fragment wound entering the right frontal area with its exit in the parieto-occipital area on the same side, March 2, 1945. The wounds were debrided at an evacuation hospital the day following injury. Depressed bone fragments and metallic foreign bodies were removed. The dura and scalp were adequately closed. By air evacuation, he was transferred to this hospital. He was irrational and incontinent. Aphasia and agnosia were demonstrated. (It later developed that the patient was left-handed.) A left hemiplegia and left homonymous hemianopsia were also seen. X-rays showed a nest of bone fragments in the right frontal lobe. Laboratory work showed a hemoglobin of 50 per cent and a leukocyte count of 14,000. Transfusions were given and the hemoglobin rose to the range of normal within a week. Despite supportive therapy, the general condition and level of consciousness failed to improve. Papilledema developed. A lumbar puncture was done which showed the pressure to be 400 millimeters of water and the white cell count 5. Twenty thousand units of penicillin were given every three hours and a blood level of 6 to 10 milligrams of sulfadiazine was maintained.

Operation: A diagnosis of brain abscess around the cluster of retained bone fragments in the right frontal lobe was made, and on March 21—19 days following his injury—exploration under local anesthesia was performed. When the dura was opened the brain was so tense that it was impossible to inspect the missile tract. A lumbar puncture was done and a few c.c. of spinal fluid removed to facilitate access to the abscess. A brain needle was inserted into the abscess cavity and evacuation of the contents provided additional relaxation of the brain. The capsule was thick and it was possible to shell out the abscess intact. X-ray films had shown the bone chips to be quite close to the ventricle and they were not present in the abscess wall. Removal of the bone chips was deliberately left for a future date to avoid introduction of pus into

the ventricular system. The patient seemed to grow more alert as the abscess content and its wall were removed. One hundred thousand units of penicillin were placed in the wound. The dura, galea, and skin were closed with interrupted sutures of black silk. Smears of the pus showed gram positive cocci singly, in pairs and in short chains.

Cultures produced an anerobic streptococcus viridans.

Following this procedure the patient improved for a few days, although the papilledema persisted. On March 26, the posterior parietal wound was noted to be tense and bulging. A diagnosis of parietal lobe abscess was made and on March 31 he was again operated upon under local anesthesia. The parietal wound was opened. The dural closure had separated and necrotic brain had extruded into the subgaleal space. This material was sucked away and beneath it was found a large abscess which measured 5 centimeters in diameter. The wall of the abscess was quite thick and it was removed completely. One hundred thousand units of penicillin were placed in the cerebral defect. The dura, galea, and skin were closed with interrupted sutures of silk. Penicillin and sulfadiazine therapy was continued postoperatively.

TABLE II
Statistical Data

	Number of Cases	Per Cent of Total
Total penetrating wounds of the cranium.....	276	100
Total craniotomies and cranioplasty procedures.....	148	
Total craniotomies	122	
Craniotomies secondarily debrided.....	104	37.6
Total number of operative cases with purulent necrosis along the missile tract in brain tissues.....	81	28.6
Total number of cases showing bacteria on direct smear or culture of deep brain tissue at surgery.....	48	17.7
Mortality for entire group.....	23	8.04
Mortality for operative group due to infection (8% of operative group)	12	4.3
Deaths without surgery with brain infections.....	5	1.8
Mortality directly due to extent of trauma.....	5	1.8
Mortality due to postoperative hematoma.....	1	.36
Survival gram negative bacillus meningitis.....	1	.36

Smears of the pus from this abscess, examined during the operation, showed many leukocytes and gram positive cocci singly and in pairs. The bacterial flora demonstrated on culture was quite different from those from the frontal abscess. A hemolytic staphylococcus albus, and gamma streptococci were found. The patient's condition improved rapidly, and in a few days he was able to walk with the aid of attendants and enjoyed sitting in a chair.

On May 15, the frontal area was again explored. A lumbar puncture was done and enough fluid removed to allow the missile tract and abscess cavity to open. The scar tissue formation in the wall of this cavity was minimal. Three large bone fragments and their surrounding glial scar were located without difficulty near the wall of the ventricle and removed. Penicillin, 100,000 units, was placed in the cerebral defect and the wound closed. Following this procedure the patient's condition continued to improve. The

hemiplegia and homonymous hemianopsia persisted. The papilledema subsided. Speech was returning slowly and he was able to walk with crutches at the time of his transfer by air evacuation to the United States.

The cases that have been cited demonstrate the typical picture observed in patients who develop infection in the missile tract of the brain substance from organisms that have a relatively high degree of sensitivity to the antibiotics which were available during World War II. In our experience the brain substance itself is quite able, with the therapeutic adjuncts, to handle these types of infections. No fatalities were encountered in those cases in which the ventricles were entered and in which infection was limited to organisms sensitive to the available antibiotics.

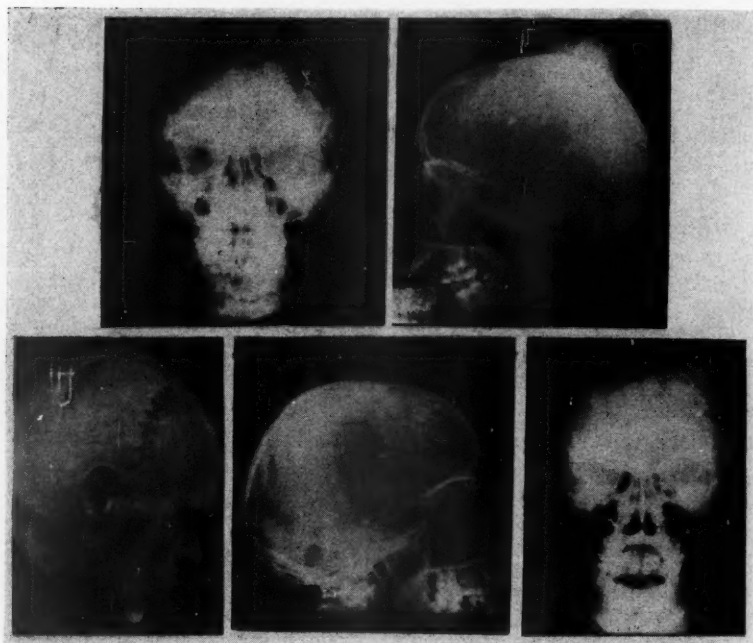
Several patients had infections of the cerebral substance which were due to gram negative bacilli that are penicillin and sulfa resistant. Five patients survived such infections of the cerebral substance without ventricular involvement (Table 2). An example of such an instance is cited (fig. 3).

CASE 4. A. P. O., a staff sergeant, received a penetrating wound in the right temporal region due to a high explosive shell fragment, Nov. 12, 1944. His wound was debrided on that day at an evacuation hospital. He was admitted through the usual surface chain of evacuation to this hospital on November 24. On admission there was a dehiscence of the wound in the temporoparietal area through which a cerebral fungus protruded, measuring approximately 4 centimeters in diameter. The patient had a left spastic hemiplegia with hyperactive reflexes and left Babinski. There was a right supranuclear facial paralysis. The fundi were normal. X-rays revealed a small metallic foreign body and a cluster of bone chips in the cerebral substance beneath the fungus. The patient's condition was quite critical, and plasma and blood transfusions were necessary supportive measures.

He was taken to the operating room the day following admission. The necrotic fungating brain was removed; the flap used at the original debridement was turned down to expose the bone defect. Directly beneath the bony defect a cavity was found about 3.5 centimeters in depth containing necrotic brain, bone, debris and pus. A smear of this showed gram positive cocci. The bone fragments were removed. Fifty thousand units of penicillin were placed in the debrided cavity. The dura was closed with a temporofascial graft and the scalp sutured with silk. The posterior portion was not closed in order to avoid tension at the site of the wound. During the procedure 500 c.c. of blood and one unit of plasma were given. The patient's condition was critical throughout the operation.

Cultures revealed a *Klebsiellae pneumoniae*, hemolytic *staphylococcus aureus* and a gamma *staphylococcus* as the organisms in this wound. The postoperative course was quite good and there was progressive improvement. The patient was able to get up in a few days with assistance, and was later able to use crutches. A left homonymous hemianopsia was demonstrable as he became more rational.

Postoperative x-rays showed the presence of 3 small bone chips overlooked



Case 3. Pre- and postoperative x-rays and photograph.

at the secondary debridement. As a result, on December 28, the temporal flap was again turned down; the dural graft was healed and it was reopened. The 3 small bone fragments were removed from the cerebral substance just beneath the dura. A small foreign body in this same area could not be found. The brain was surprisingly well healed with a minimal amount of scar tissue formation. A tantalum plate was fitted over the bony defect and the wound was closed with interrupted sutures of black silk.

Postoperatively his condition remained satisfactory. At the time of evacuation to the United States he was ambulatory and asymptomatic except for his hemiparesis.

In the last war a penetrating wound of the ventricle was a very grave matter and carried with it a very high mortality. The exact figures are not available. One observer, Dr. J. E. J. King, did not recall any cases which he personally observed that survived. In approximately 35 cases of over 276 admissions, penetration of the ventricle was seen. Table 2 lists 3 cases that were admitted to the hospital with traumatic ventriculostomies and their bacterial flora. An attempt was made to close these three but in no case did the patient survive. The significant finding in each case was the gram negative characteristics of the bacterial flora against which avail-

able antibiotics had no effect. In 19 cases during the process of secondary debridement the ventricles were opened. In 6 instances the ventricle was opened in the presence of pus from which active organisms belonging to penicillin and sulfa sensitive strains were grown. Seven cases were opened in the presence of sterile pus. Five demonstrated nothing more than porencephalic extensions of the ventricle to the dura along the missile tract.

The gram negative organisms with closely allied grown characteristics and morphology are: *Klebsiellae pneumoniae*, type A; *Klebsiellae pneumoniae*, type B; *Aerobacter aerogenes*, *Bacillus proteus*, *Escherichia coli* and para *Escherichia coli*. Infection from the first two organisms, *Klebsiellae pneumoniae* and *Aerobacter aerogenes*, have proved to be the most dangerous of the infections encountered in this study. The clinical observations of this paper will further elaborate their role as a cause of death following penetrating cerebral wounds, and the need for antibiotics to combat them.

The following case illustrated the clinical course characteristic of those patients who did not survive gram negative bacillus infections, which extended into the meninges.

CASE 5. This staff sergeant (F. H.), who appeared to be about 29 years of age, was admitted on Feb. 10, 1945. He was wounded in action in Germany on February 2, having received a shell fragment wound of the left temporo-parietal region. Immediate aphasia and right hemiplegia developed. Craniotomy with debridement of the brain was done at an evacuation hospital under local anesthesia on the day that he was wounded. He had received penicillin and sulfadiazine therapy continuously through the period of his transportation from the evacuation hospital to this hospital.

On admission the patient had a global aphasia. There was a large wound in the left parietal region from which pus was draining. There were smaller wounds of the temporal region which were partially healed. The pupils were regular and equal and reacted to light. Examination of the fundi showed bilateral choking of 1.5 diopters with small hemorrhages around the margins of both discs. There was a lower facial paralysis and spastic right hemiplegia with hyperactive reflexes. The plantar response on the right was upward. X-rays were taken which showed no evidence of retained intracranial bone fragments or foreign bodies; radiating fracture lines were seen around the cranial defect in the left parietal area. The patient was placed on penicillin and sulfadiazine. Neck rigidity was present throughout his course. On February 15 a fungus cerebri developed at the site of his draining wound.

Operation: On February 16 a craniotomy was done with enucleation of a large abscess involving the greater portion of the left temporal and parietal lobes. Smears and cultures taken at the time of surgery showed the predominant organisms to be a *Klebsiellae pneumoniae*, type A. Eighty thousand units of penicillin were given intraspinally immediately after the operation. The wound was closed without tension using interrupted sutures of silk.

Postoperatively his condition failed to improve. A lumbar puncture done on February 17 showed cloudy fluid indicative of meningitis. Intrathecal

TABLE III
Organisms, Culture from Brain at Time of Operation

Hemolytic staphylococcus aureus.....	13
Beta hemolytic streptococcus.....	1
Streptococcus viridans	13
Staphylococcus citreus	1
Non-hemolytic staphylococcus albus.....	22
Hemolytic staphylococcus albus.....	6
Gamma streptococcus	9
Para colon bacillus.....	1
Micrococcus tetragenes	5
Clostridium sporogenes	2
Clostridium welchii	3
Klebsiellae Species:	
Klebsiellae untyped	6
Klebsiellae, type A.....	1
Klebsiellae, type B.....	0
Aerobacter aerogenes	1
Alkalegenes faecalis	1
Anerobic gamma streptococcus.....	1
Diphtheroids	2
Bacterioides	1
Escherichia coli	4
Pfeifferella whitmorei	1
Bacillus subtilis	3
Microaerophilic gamma streptococcus.....	4

penicillin therapy was instituted, using 20,000 units of penicillin twice daily. His temperature remained 103° and 104°. He constantly showed a positive Kernig and nuchal rigidity. Cerebrospinal fluid began to drain from the head wound. Lumbar punctures were unsatisfactory in a few days because of the tenacious purulent character of the spinal fluid. He developed a paralysis of swallowing and it was necessary to give him nourishment by the intravenous route. During his course, the patient was given massive doses of urea to obtain a blood level of 38 milligrams per cent of urea nitrogen. Despite the supportive and antibiotic treatment, his course was progressively downhill. On February 26 he developed signs of increasing intracranial pressure—coma developed, his wound began to bulge, there was dilatation of the right pupil and his breathing became labored. He was taken to the operating room and on reopening the wound, considerable edematous brain and pus extruded. Open drainage was instituted, using the method described by Dr. King. He improved following this procedure. His pupils became equal, his breathing was less labored. Later in the day, however, his temperature rose to 106° and he died the following day.

At autopsy the scalp was removed from the calvarium with difficulty due to hemorrhage and edema. The skull showed radiating fractures of the calvarium. The central point of the radiating fracture showed the craniectomy defect in the left parietal bone parallel to the superior sagittal sinus. The defect measured approximately 7 centimeters in length and about 2.5 centimeters in width. The calvarium was removed with ease and reflection of the dura exposed the brain covered with a thick tenacious purulent exudate. The convolutions of the brain were so flattened that the sulci were obliterated. As

TABLE IV
Bacterial Flora in Deaths Due to Infection

Klebsiellae pneumoniae untyped.....	4
Klebsiellae pneumoniae, type A.....	2
Klebsiellae pneumoniae, type B.....	1
Aerobacter aerogenes	2
Clostridium welchii	1
Clostridium sporogenes	1
Streptococcus viridans	1
Hemolytic staphylococcus aureus.....	1
Para colon bacillus.....	1
Shigella minutissima	1
Non-hemolytic staphylococcus albus.....	1
Escherichia coli	1

the brain was removed, the same exudate could be seen over the surfaces of the cerebellum and a very large amount was present in the region of the pons and medulla, filling the basal cisterna. Dissection of the brain revealed an infected sinus tract which extended from the surface of the left parietal lobe downward and medially to enter the left lateral ventricle involving the left internal capsule in its course. The lateral ventricles, the third ventricle, the aqueduct of sylvius, and the fourth ventricle contained a large amount of greenish fibrinous exudate. Direct smears taken from the surface of the brain showed a gram negative bacillus. Cultures confirmed the findings at surgery of *Klebsiellae pneumoniae*, Type A.

This case shows the typical postmortem findings of a patient who died from a meningitis due to a gram negative bacillus. The infection does not produce too toxic a reaction. The course is that of increased intracranial pressure, and is not a rapid fulminating terminal illness. The autopsy findings are characteristic. There is blockage to the normal flow of cerebrospinal fluid with resulting increased pressure, ventricular enlargement, blockage of the ventricles by purulent exudate and absence of subarachnoid fluid. The basal cisterns are filled with exudate, and in this particular case a subdural extension of the infection had occurred. The exudative reaction produced by this infection seems to be its most prominent characteristic when the meninges are involved.

The following case represents the only known patient who survived an overwhelming meningitic infection due to *Aerobacter aerogenes* associated with a penetrating wound during World War II.

CASE 6. B. D. was wounded in action April 12, 1945. He had sustained a penetrating shell fragment wound of the left temporal region. The wound was debrided and closed at an evacuation hospital on the day he was wounded.

On admission to this hospital on April 22, there was an open wound in the left temporal area from which pus exuded. He reacted sluggishly but intelligently to questions. A moderate weakness of the right upper extremity was demonstrated. Cooperation was too poor to permit visual field studies. Wet

TABLE V
Deaths with Open Ventricle at Time of Surgery

N.M.	Ventriculostomy meningitis	Escherichia coli.
F.H.	Ventriculostomy meningitis	Clostridium sporogenes. Streptococcus viridans. Hemolytic staphylococcus aureus. Klebsiellae pneumoniae, type A.
C.F.	Ventriculostomy meningitis	Hemolytic staphylococcus aureus. Non-hemolytic staphylococcus albus. Diphtheroids. Clostridium welchii. Klebsiellae pneumoniae.

Surgical Deaths Secondarily Debrided with Meningeal Infections

C.S.	Cerebral fungus and abscess communicating with the ventricle, right temporal horn, and meningitis.	Friedlander's bacilli. Hemolytic staphylococcus aureus.
D.A.W.	Meningitis with thick purulent exudate.	Shigella minutissima.
J.N.	Large parieto-occipital abscess and meningitis.	Clostridium welchii. Aerobacter aerogenes.
R.F.	Large abscess with poorly formed capsule, frontal and parietal areas, and meningitis.	Friedlander's bacillus. Gamma streptococcus. Staphylococcus aureus.

dressings were placed on the wound and cultures taken of the superficial drainage produced a staphylococcus aureus. X-rays showed numerous retained bone and metallic fragments of the left temporal lobe. The temperature was normal on admission. Hemoglobin was 76; red blood cells 3,800,000; white blood cells, 9,600; urinalysis was negative.

Operation: On April 27, the patient was taken to the operating room and following induction with gas-oxygen-ether anesthesia the wound was draped and the superficial tissues excised. A secondary closure was carried out superficial to the temporalis muscle. He was maintained on adequate doses of penicillin and sulfadiazine from the day of admission. On May 14, a temporal scalp flap was turned down to avoid going through the wound which had been secondarily closed and had healed satisfactorily. The temporalis muscle was reflected downward with this scalp flap. The dura was opened at the anterior margin of the defect and a pocket of pus was found immediately beneath the dura. Seventeen small bone chips were removed. The abscess wall around the pus was resected. The tip of the temporal horn of the ventricle was entered during the process of removing this abscess wall. Smears made on the pus from the abscess cavity showed many white cells but no bacteria. Cultures showed *Aerobacter aerogenes* present in the abscess.

Following surgery cerebrospinal fluid drained from the wound for five days. Temperature fluctuated between 99° and 103° daily. Meningismus was observed the day after surgery. The patient responded well and took food and fluids without difficulty. A spinal tap done the day after surgery revealed a cloudy fluid which showed pus cells but no organisms on direct smear. The white blood count on this spinal fluid was 1,325 with 82 per cent polymorphonuclear cells. *Aerobacter aerogenes* were isolated on culture of the fluid.

Following the identification of the organism as *Aerobacter aerogenes*, the sulfadiazine dosage was doubled to 2 grams every four hours. One hundred and twenty grams of urea were given daily by mouth. Fluid intake was increased to 5,000 c.c. daily. The penicillin dosage was increased to 50,000 units every three hours. Despite the intensive antibiotic therapy, his temperature continued to rise. Spinal taps were done three times daily and 15,000 units of penicillin were placed in the spinal canal at each puncture. This did not improve his condition. On the seventh and eighth postoperative days, the temperature reached 104° and remained at this level. The spinal puncture examinations showed organisms on direct smear. Considerable fibrin began to appear in the spinal fluid although the cellular increase was minimal. On the eighth postoperative day the spinal fluid was found to contain 5,950 leukocytes and the differential count showed 87 per cent polymorphonuclear cells and 13 per cent lymphocytes.

On the eighth postoperative day 40 milligrams of a 2 per cent solution of chloral hydrate sterilized by filtration through a Seitz filter were injected intraspinally without any apparent reaction. The spinal fluid was mixed well with the chloral hydrate as it was injected. Later that day, 200 milligrams of chloral hydrate were administered to this patient in the same manner. On the following day the spinal tap revealed no organisms from direct smear and the culture did not grow any organisms. On the ninth postoperative day, 600 milligrams each were administered. The spinal fluid remained sterile. The gross appearance gradually became clearer. The cell count dropped to 100 cells in five days from its former level of 5,950. After the sixth day of chloral hydrate therapy, this medication was discontinued; penicillin and sulfadiazine therapy was discontinued ten days later.

When last observed on June 23, 1945, this patient was ambulatory and completely free of any evidence of meningitis or any residual complaints.

COMMENT

The use of chloral hydrate intrathecally as a means of combating infection from *Aerobacter aerogenes* was suggested by 1st Lt. Harry Bleckman. He had suggested that this drug had been used effectively in commercial dairy laboratories and public health laboratories to control overgrowth of gram negative organisms, particularly the coli group in milk cultures. Lt. Bleckman and one of us (L.H.S.) utilized this drug in broth cultures. It was found that 200 milligrams per cent effectively prevented growth of *Klebsiellae pneumoniae* in broth cultures. Rabbits were obtained and doses injected intrathecally were tolerated without ill effect. Sacrifice of the animals after a period of two weeks revealed no gross or microscopic evidence of damage to the central nervous system.

TABLE VI
Cultures and Smear Examination Made at Time of Surgery

<i>Date</i>	<i>Name</i>	<i>Smear</i>	<i>Culture</i>
15 June 1944	H.M.	Cortex. Many W.B.C., few R.B.C. No organisms seen.	Micrococcus tetragenes. Staphylococcus albus hemolyticus.
17 June 1944	J.V.	Deep Brain. Few W.B.C., few R.B.C. No organisms seen.	Non-hemolytic staphylococcus albus. Micrococcus tetragenes. Non-hemolytic gamma streptococcus.
17 June 1944	R.F.	Few W.B.C. Gram positive cocci singly and pairs.	Non-hemolytic staphylococcus albus and streptococcus viridans.
17 June 1944	F.F.	Few W.B.C. Gram positive cocci singly and pairs.	Non-hemolytic staphylococcus albus. Gamma streptococcus.
23 June 1944	R.R.	Few W.B.C. No organisms seen.	Non-hemolytic staphylococcus albus.
26 June 1944	V.P.	Few W.B.C. No organisms seen.	No growth.
26 June 1944	W.H.	Few W.B.C. Gram positive cocci singly and pairs.	No growth. No growth. No growth. Slightly hemolytic staphylococcus albus.

<i>Date</i>	<i>Name</i>	<i>Smear</i>	<i>Culture</i>
27 June 1944	G.R.	Few W.B.C. Gram positive cocci singly and pairs.	Non-hemolytic staphylococcus albus. Hemolytic staphylococcus aureus.
5 July 1944	S.D.	Few W.B.C., few R.B.C. No organisms seen.	No growth.
7 July 1944	R.C.	Scalp flap. Few W.B.C. Gram positive cocci singly and pairs. Cortex. Few W.B.C. Gram positive cocci singly and pairs.	Bacillus subtilis. Streptococcus viridans. Escherichia coli.
20 July 1944	R.	Few W.B.C. Gram positive cocci singly and pairs. Gram positive bacilli.	Streptococcus viridans. Escherichia coli.
22 July 1944	M.J.H.	Few W.B.C. No organisms seen.	Hemolytic staphylococcus aureus. Streptococcus viridans. Bacillus subtilis. Klebsiellae pneumoniae. Clostridium welchii.
23 July 1944	N.W.Mc.	Few W.B.C. No organisms seen.	Micrococcus tetragenes. Streptococcus viridans. Micro-aerophilic gamma streptococcus. Streptococcus viridans.
25 July 1944	E.N.	Cortex. Few W.B.C. Gram positive cocci singly and pairs.	Non-hemolytic staphylococcus albus. Micro-aerophilic gamma streptococcus.

<i>Date</i>	<i>Name</i>	<i>Smear</i>	<i>Culture</i>
26 July 1944	M.B.	Deep Brain. Many W.B.C. Gram positive cocci singly and pairs. Swab dry.	Non-hemolytic staphylococcus albus.
28 July 1944	M.F.T.	Few W.B.C. No organisms seen.	Micrococcus tetragenes. Alcaligenes faecalis.
3 Aug. 1944	G.V.	Few W.B.C. No organisms seen.	Streptococcus viridans. Hemolytic staphylococcus aureus.
5 Aug. 1944	W.R.	Few W.B.C. No organisms seen.	No growth.
10 Aug. 1944	O.C.C.	Many W.B.C. No organisms seen.	No growth.
15 Aug. 1944	S.T.	Few W.B.C. Gram positive cocci singly and pairs. Gram negative bacilli.	Micro-aerophilic gamma streptococcus. Escherichia coli.
17 Aug. 1944	G.F.	Few W.B.C. No organisms seen.	Klebsiellae pneumoniae. Clostridium sporogenes.
25 Aug. 1944	P.K.	Few W.B.C. No organisms seen.	No growth.
29 Aug. 1944	C.W.A.	Few W.B.C. No organisms seen.	No growth.

<i>Date</i>	<i>Name</i>	<i>Smear</i>	<i>Culture</i>
30 Aug. 1944	P.W.F.	Few W.B.C. No organisms seen.	No growth.
5 Sept. 1944	D.W.	Many W.B.C. Gram negative bacilli.	Streptococcus viridans. Klebsiella pneumoniae.
6 Sept. 1944	J.B.I.	Many W.B.C. No organisms seen.	Non-hemolytic staphylococcus albus.
7 Sept. 1944	R.L.B.	Many W.B.C. Gram positive cocci singly and pairs.	Slightly hemolytic staphylococcus albus. Gamma streptococcus.
8 Sept. 1944	L.W.W.	Many W.B.C. No organisms seen.	Streptococcus viridans. Non-hemolytic staphylococcus albus.
9 Sept. 1944	R.W.H.	Few W.B.C. No organisms seen.	No growth.
11 Sept. 1944	W.H.	Few W.B.C. No organisms seen.	Slightly hemolytic staphylococcus albus. Micrococcus tetragenes.
12 Sept. 1944	C.R.	Few W.B.C. No organisms seen.	No growth.
12 Sept. 1944	V.Z.	Few W.B.C. No organisms seen.	Non-hemolytic staphylococcus albus.
13 Sept. 1944	E.M.	Few W.B.C. No organisms seen.	No growth.
14 Sept. 1944	D.H.	Few W.B.C. Gram positive cocci singly and pairs.	Slightly hemolytic staphylococcus albus.

<i>Date</i>	<i>Name</i>	<i>Smear</i>	<i>Culture</i>
15 Sept. 1944	L.M.	Few W.B.C. No organisms seen.	Slightly hemolytic staphylococcus albus.
16 Sept. 1944	G.W.	Few W.B.C. No organisms seen.	No growth.
19 Sept. 1944	P.C.	Few W.B.C. No organisms seen.	No growth.
27 Sept. 1944	K.D.	Few W.B.C. No organisms seen.	Slightly hemolytic staphylococcus albus.
2 Oct. 1944	J.O.	Few W.B.C. No organisms seen.	Non-hemolytic staphylococcus albus. Gamma streptococcus.
4 Oct. 1944	E.F.	Few W.B.C. No organisms seen.	No growth.
9 Oct. 1944	J.H.G.	Few W.B.C. No organisms seen.	Bacterioides. Anaerobic gamma streptococcus.
10 Oct. 1944	R.H.F.	Few W.B.C. No organisms seen.	Non-hemolytic staphylococcus albus.
11 Oct. 1944	P.A.N.	Few W.B.C. No organisms seen.	No growth.
3 Nov. 1944	H.H.	Few W.B.C. Gram positive cocci.	Non-hemolytic staphylococcus albus.
7 Nov. 1944	A.H.R.	Few W.B.C. Gram positive cocci singly and pairs. Gram positive bacilli.	Streptococcus viridans. Non-hemolytic staphylococcus albus. Bacillus subtilis.

<i>Date</i>	<i>Name</i>	<i>Smear</i>	<i>Culture</i>
8 Nov. 1944	P.O.	Few W.B.C. No organisms seen.	Hemolytic staphylococcus aureus.
14 Nov. 1944	H.H.	Few W.B.C. No organisms seen.	No growth.
15 Nov. 1944	J.H.	Few W.B.C. No organisms seen.	No growth.
25 Nov. 1944	A.O.	Few W.B.C. No organisms seen.	Hemolytic staphylococcus aureus. Gamma streptococcus. Klebsiellae pneumoniae.
28 Nov. 1944	H.V.	Few W.B.C. No organisms seen.	No growth.
28 Nov. 1944	H.P.	Few W.B.C. No organisms seen.	No growth.
28 Nov. 1944	L.A.B.	Few W.B.C. No organisms seen.	No growth.
29 Nov. 1944	J.H.F.	Few W.B.C., occasional R.B.C. No organisms seen.	Non-hemolytic staphylococcus albus.
5 Dec. 1944	W.G.	Many W.B.C. Gram positive cocci singly and pairs and short chains.	Hemolytic staphylococcus aureus. Streptococcus viridans.
5 Dec. 1944	D.H.	Few W.B.C. No organisms seen.	No growth.

<i>Date</i>	<i>Name</i>	<i>Smear</i>	<i>Culture</i>
6 Dec. 1944	J.O.	Few W.B.C. No organisms seen.	No growth.
9 Dec. 1944	J.D.G.	Few W.B.C. No organisms seen.	No growth.
12 Dec. 1944	G.C.	Few W.B.C. Occasional gram positive cocci.	Non-hemolytic staphylococcus albus.
18 Dec. 1944	J.S.G.	Occasional W.B.C. No organisms seen.	Gamma streptococcus. Non-hemolytic staphylococcus albus. Paracolon bacillus.
22 Dec. 1944	D.B.	Occasional W.B.C. No organisms seen.	Gamma streptococcus. Micro-aerophilic.
23 Dec. 1944	L.C.	Occasional W.B.C. No organisms seen.	No growth.
8 Jan. 1945	R.H.	Occasional W.B.C. No organisms seen.	No growth.
9 Jan. 1945	C.D.R.	Occasional W.B.C. No organisms seen.	No growth.
9 Jan. 1945	M.R.T.	Few W.B.C., few R.B.C. No organisms seen.	Micrococcus tetragenes.
10 Jan. 1945	T.P.	Few W.B.C. No organisms seen.	No growth.
11 Jan. 1945	J.T.W.	Few W.B.C. No organisms seen.	No growth.

<i>Date</i>	<i>Name</i>	<i>Smear</i>	<i>Culture</i>
16 Feb. 1945	F.H.	Few W.B.C. Gram negative bacilli.	Clostridium sporogenes. Streptococcus viridans. Hemolytic staphylococcus aureus. Klebsiellae species. Non-hemolytic staphylococcus albus.
20 Feb. 1945	J.P.	Few W.B.C. Gram positive cocci singly and pairs.	
21 Feb. 1945	P.G.	Few W.B.C. Gram positive cocci singly and pairs.	Streptococcus viridans. Clostridium welchii.
8 Mar. 1945	O.C.	Few W.B.C. No organisms seen.	No growth.
19 Mar. 1945	J.M.	Few W.B.C. Gram negative bacilli.	Klebsiellae pneumoniae, type A. Beta hemolytic streptococcus.
21 Mar. 1945	R.C.	Few W.B.C. No organisms seen.	No growth.
21 Mar. 1945	N.P.	Many W.B.C. Gram positive cocci singly and pairs and short chains.	Anaerobic. Streptococcus viridans.
28 Mar. 1945	T.R.	Few W.B.C. Gram positive cocci singly, pairs and short chains. Gram positive bacilli.	No growth.
30 Mar. 1945	P.D.	Many W.B.C. No organisms seen.	No growth.

<i>Date</i>	<i>Name</i>	<i>Smear</i>	<i>Culture</i>
31 Mar. 1945	N.P.	Many W.B.C. Gram positive cocci singly and pairs.	Hemolytic staphylococcus aureus. Non-hemolytic staphylococcus albus. Gamma streptococcus.
16 April 1945	A.K.	Few W.B.C. No organisms seen.	Hemolytic staphylococcus aureus. Non-hemolytic staphylococcus albus.
24 April 1945	C.F.	Many W.B.C. Gram positive cocci singly and pairs. Gram negative bacilli. Gram positive bacilli.	Hemolytic staphylococcus aureus. Non-hemolytic staphylococcus albus. Diphtheroids. Escherichia coli. Clostridium welchii.
26 April 1945	V.W.D.	Few W.B.C. Diphtheroids.	Pfeifferella whitmori. Non-hemolytic staphylococcus albus. Diphtheroids.
27 April 1945	C.R.	Few W.B.C. No organisms seen.	Hemolytic staphylococcus aureus. Non-hemolytic staphylococcus. Escherichia coli.
1 May 1945	S.C.	Few W.B.C. No organisms seen.	No growth.
3 May 1945	G.C.	Few W.B.C. No organisms seen.	No growth.

Comparing the list of flora encountered in Table III, in the overall operative group, with the bacteria cultured from the deaths due to infection in Table IV and V, it is quite obvious how disastrous the infections of meninges by a gram negative bacillus can be. As these findings accumulated it was apparent that we were helpless to combat these infections once they entered the ventricle or subarachnoid space. The brain seemed to be able to handle these bacillary infections when the infection was limited to cerebral tissue without difficulty, Case 4, and five patients survived without developing meningitis, Table III. The clinical experience with gram negative bacillary meningitis associated with penetrating cerebral wounds was discussed with each of the neurologic surgeons in the United States Army neurologic centers, in the European Theater of Operations. The mortality rate was 100 per cent.

Capsule formation around the abscess containing these organisms was never as thick as found around other abscesses, and in some of the more rapidly fatal cases no cicatrix was present. This was particularly true in the patients who were too ill for surgical consideration. Two deaths occurred from *Klebsiellae* infection of the meninges following penetrating wounds of the spine.

The one patient surviving an *Aerobacter aerogenes* meningitis was treated with intrathecal chloral hydrate (Case 6). This was the last patient admitted with a gram negative bacillus infection of the meninges. Newer antibiotics, streptomycin and aureomycin, offer an opportunity to combat infections of the meninges by gram negative bacilli; however, these were not available at the time these patients were observed.

Nearly all patients with proved infections were followed for four weeks after their last surgical procedure. After transfer to the Continental United States, follow-up studies were limited to a very few patients. Abscesses were rarely seen in the General Hospitals here. In several hundred craniocerebral wounds observed on the neurosurgical service of one general hospital in the Continental United States two abscesses were found. These were patients who for some reason were inadequately debrided and were not reexplored until diagnosed at the hospital.

SUMMARY AND CONCLUSIONS

1. A comprehensive study of infections of the brain emphasizes the importance of meticulous, thorough surgical debridement of craniocerebral wounds, realizing the limitation often imposed by the neurologic and general condition of the patient.
2. Gram negative bacillary infections, particularly the *Klebsiellae*

group, are the most dangerous infections encountered. The brain tissue can combat these organisms satisfactorily. Only one patient in this group survived an infection of the meninges due to a gram negative bacillus (*Aerobacter aerogenes*).

3. Sulfadiazine and penicillin were most effective in controlling infections of the brain and meninges from all other organisms that were cultured at operation.

4. The practice of excision of abscesses and wound closure without drainage proved to be most satisfactory. Unsatisfactory results using this technic were not observed. The only two cases in which open drainage was used proved to be hopeless gram negative infections with meningeal involvement.

5. The use of urea in large amounts by mouth did not prove to be of any definite value as a synergistic agent with the antibiotics.

6. Chloral hydrate which has a specific effect on gram negative bacilli in vitro proved effective in combating an overwhelming meningitis due to *Aerobacter aerogenes*. This is the only known instance of its usage in this fashion.

7. Chloral hydrate is not recommended as a means of combating infections of the meninges by gram negative organisms as aureomycin and streptomycin are now available and are effective against these organisms and other effective antibiotics are being developed.

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A NEW SURGICAL PROCEDURE IN SCOLIOSIS THERAPY

Unilateral Vertebral Body Growth Arrest by Transpleural Approach

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THIS is a preliminary report on a new surgical procedure performed in the treatment of scoliosis. The operation was performed Nov. 25, 1949, at Emory University Hospital through the combined efforts of orthopedic and thoracic surgeons.

Passive correction of a spinal curvature by external appliances, followed by fusion of a segment of the vertebral column, has been the most commonly employed method of active treatment in progressive scoliosis. This method falls short, however, in directly attacking the anatomic site where fundamental corrective forces are required, *e.g.*, the vertebral *body*.

Bick and Copel² have recently shown that osteogenesis in the vertebral body begins as an expanding osteoblastic center and continues until the center reaches the periphery, and then forms cephalic and caudal epiphyseal plates. Longitudinal growth of the vertebral body then continues to maturity as in the diaphyses of long bones.

These columns at the cephalic and caudal surfaces, characteristic of true epiphyseal plates, are first noted in the 21 cm. fetus. Disappearance of the vertebral epiphyseal plates is noted at 17 and 18 years.

Arkin¹ has demonstrated that scoliosis can be induced by radiation where the source is located laterally and the entire vertebral epiphyseal plate is not uniformly, but rather, eccentrically, irradiated. Controlled growth arrest by radiation, unfortunately, does not appear feasible at present.

Blount,³ following the fundamental work by Phemister⁶ and Haas,^{4,5} has shown that longitudinal growth in long bones, especially the tibia and femur, can be effectively controlled by the application of staples across the epiphyseal plate. This principle is being used successfully in the correction of leg length disparity, bow-leg, knock-knee, and other similar deformities.

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The following case is the first report of the application of this method for unilateral growth arrest in a vertebral body.

CASE REPORT

E.K., an 11 year old white girl, was first examined in the Crippled Childrens Division in June, 1946, at which time diagnoses of functional scoliosis, right dorsal and left lumbar, and pes planus, bilateral, were made. The patient was hospitalized for instruction in exercises, fitting of a brace, and shoe corrections at that time. She was discharged in September, 1946, "slightly improved."

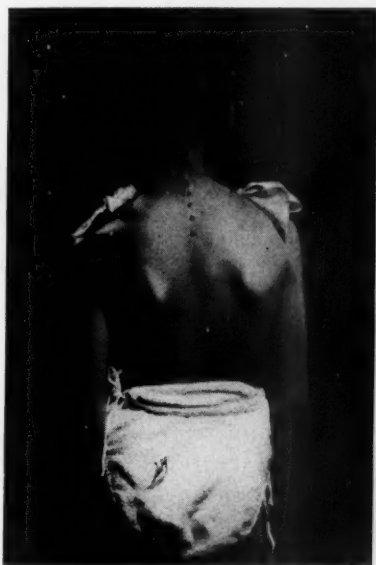


Fig. 1. Preoperative view of back showing right dorsal scoliosis.



Fig. 2. Preoperative roentgenogram showing degree of right dorsal scoliosis.

In March, 1947, she was again examined in the Crippled Childrens Division and follow-up examinations were carried out at intervals of approximately every two months until Jan. 6, 1948. At this time, examination revealed slight lowering of the pelvis on the right side with a shift of the trunk to the right. There was a prominence of the scapula and the right rib cage due to clockwise vertebral rotation in the dorsal region. Roentgenograms revealed a long primary dorsal curve (D3-L1) of 15 degrees, unaltered either by sitting or standing. Compared with roentgen examination in October, 1947, there was only slight increase in the degree of curvature. Her back brace was adjusted and exercises were begun.

On April 6, 1948, in spite of diligent exercise and a brace, an increase in the right dorsal curve and prominence of the right scapula and rib cage were observed. This was present despite good mobility. She was admitted to Emory

University Hospital on April 8, 1948, for axis and leg traction and lateral trunk traction. This was instituted and the patient was placed under the supervision of Dr. Robert L. Bennett and Miss Beatrice Woodcock of the Georgia Warm Springs Foundation for corrective exercises. These were continued through June 26, 1948, with resultant increased muscle tone in the above areas and the shoulder girdles, and increased flexibility of the primary curve. The patient continued exercises after she was discharged. A corrective cellulose acetate body jacket was worn to maintain correction.

On Sept. 21, 1948, examination revealed excellent flexibility of the primary curve as a result of exercises. However, roentgenograms compared with those of Jan. 6, 1948, showed a slight but definite increase in the curvature of the dorsal spine.

On June 28, 1948, examination revealed a pelvic tilt, low on the right with evidence of progressive rib cage deformity. The scoliosis was partially corrected with a one-half inch raise under the right heel. On Sept. 27, 1949, roentgenograms revealed a slowly progressing deformity of the dorsal curve and there was evidence of decreased flexibility.

On Nov. 22, 1949, examination revealed the apex of the curve to be located at D-9 and because of gradual progression of the curve as evidenced by both roentgenograms and the degree of deformity of the right thoracic cage, it was decided that the patient should be subjected to stapling of the bodies of five vertebrae on the convex side of the curve. A transthoracic approach with the aid of the thoracic surgeons was performed on Nov. 25, 1949.

OPERATIVE PROCEDURE

Under endotracheal anesthesia, an incision was made over the level of the eighth interspace from the midline of the back anteriorly to the lower costal margins. Dissection was carried down through the paravertebral muscles. The bases of the eighth, ninth, and tenth ribs were cut at the level of the erector spinae muscles. The pleural cavity was entered through the eighth interspace. The pleura was found to be completely free of adhesions. The lung was retracted medially and the posterior parietal pleura was incised along the margins of the vertebral bodies. Three intercostal vessels were ligated.

Splanchnic nerves were retracted. After insertion of one staple, an anteroposterior roentgenogram was taken to verify the level of insertion. Three staples spanned dorsal vertebral bodies 8, 9, 10, and 11; two staples connected D-7 and D-8, and two connected D-11 and D-12. Remaining staples were firmly embedded into lateral aspects of adjacent vertebral bodies. It was noted that partial correction of the scoliosis could be gained by simple lateral pressure on the bodies; however, no great corrective force was applied during the procedure. The thoracic duct was not disturbed.

Following the stapling procedure the thoracic cavity was irrigated with saline; no attempt was made to close the posterior parietal pleura. The lung was adequately reexpanded, and one mushroom catheter was used for thoracotomy drainage. The cut ends of the ribs were approximated by using intramedullary wire pegs. The intercostal space was approximated by using a pericostal suture of #2 40-day chromic catgut. The muscles, subcutaneous tissues, and skin were then closed with interrupted black silk sutures. The thoracotomy tube was connected to under-water drainage and left in place for 24 hours. The lung was well expanded at the end of that time.



Fig. 3. Roentgenogram, one month postoperative, showing staples in place and partial correction of dorsal scoliosis.



Fig. 4. Operative view demonstrating position of staples in place between bodies of seventh to twelfth dorsal vertebrae.

The patient's postoperative course was uneventful and she returned to school after the second postoperative week.

Roentgenograms taken four months postoperatively show no change in the degree of curvature nor in the positions of the staples. Clinically, the appearance of the scoliosis is definitely improved.

At the present time we are investigating staples of varied designs where the possibility of their detachment from bone is minimized. Too little time has elapsed for the full evaluation of this procedure,

but it is felt that this will offer further aid in correction of this deformity.

CONCLUSIONS

1. A new surgical procedure in the correction of scoliosis is recorded.

2. Use of the transpleural approach to the vertebral bodies for unilateral growth arrest in the surgical therapy of scoliosis offers the most direct attack on the anatomic site, *e.g.*, the vertebral *body*, where corrective forces are required.

3. Staples have been inserted into the vertebral bodies at the primary dorsal curve to produce unilateral growth arrest and to lessen the degree of deformity.

4. This procedure definitely should be a combined operation of orthopedic and thoracic surgeons. The postoperative course, likewise, should be followed by both groups. As in all thoracic procedures, the help of experienced anesthesiologists is mandatory.

5. It is hoped that modifications and refinements in this technic of unilateral vertebral *body* growth arrest will appear subsequently.

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PLASTIC SURGERY IN DERMATOLOGIC LESIONS

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PLASTIC surgery has for its purpose both the improvement in appearance and the improvement in function. In our opinion the improvement in appearance is often of equal importance to that of function, for the psychiatrist will substantiate the serious handicap to the function of the organism as a whole caused by an unsightly appearance. Obviously, however, many skin lesions must be treated surgically because of their threat to life as well as their unpleasant appearance.

Among the so-called benign lesions of the skin are the hemangiomas. They are of the capillary or cavernous types and may be flat or raised. The armamentarium for treatment of these lesions has included surgical excision (either with closure or with the grafting of skin), injection with sclerosing solutions, irradiation with x-ray or radium, application of dry ice, and others. Irradiation has a limited usefulness, and usually the dosage sufficient to cause sclerosis of the lesion leaves a mottled conspicuous scar.

The raised lesions usually respond well to injection with sclerosing solutions. Isolated and telangiectatic vessels may be eradicated by injection, and one injection usually suffices. However, in those cases in which the skin is widely involved by the hemangioma it is usually wise to select another type of treatment, for a great deal of skin scarring may result from the injections (see fig. 1).

Small lesions either raised or flat are easily excised and, if in the region of a natural crease, this is the treatment of choice. Larger lesions may be excised in stages. A lapse of two months or more is allowed for the skin to become relaxed again before each succeeding stage. Lesions of the cheek are especially amenable to this mode of treatment for the neck skin may be advanced markedly upward onto the cheek.

The most disfiguring of the hemangiomas commonly seen is the nevus flammeus or Port wine stain. It frequently involves one whole side of the face and is a source of great embarrassment to the patient. If serial excision is applicable it is the treatment of choice. Otherwise, excision and replacement by a thick split thickness skin graft is best. Though the color match of a skin graft is

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Fig. 1 A

Fig. 1 B

Fig. 1 A. Hemangioma of the chin which was removed unsuccessfully several years previously and has been injected numerous times since. Fig. 1 B. Following complete removal of the hemangioma and the worst of the scarred skin.

never as good as one would like, by obtaining a thickly calibrated graft and by placing the natural skin lines of the graft parallel to those of the skin of the face, the optimal appearance is obtained. Full thickness grafts from behind the ears are especially good in replacing the involved skin of the eyelids. Another method of treatment has been to tattoo the affected skin with a white pigment to lighten its color. Though it has not proved a wholehearted success it is worthy of further study.

Pigmented nevi, or moles, are the commonest of the skin lesions. Most people have at least a half dozen of varying sizes. In the majority of instances they are small, cause no trouble, and require no treatment. However, because of their size, their location, or their growth they do frequently require surgery.

Moles may be either pigmented or non-pigmented, flat or raised, smooth or warty, and hairy or non-hairy. The color varies from a very light brown to a bluish black. We especially advise removal for (1) those present on an extremity, the neck, the waist or other parts subject to repeated irritation, (2) those causing itching or soreness, (3) those which bleed, (4) those growing or changing in configuration or color, (5) all very dark flat moles. The most certain method of removal is complete surgical excision. When this is performed carefully, as later described, a minimal scar results.



Fig. 2 A



Fig. 2 B

Fig. 2 A. Black hairy nevus of the forehead. Fig. 2 B. Following complete removal and skin graft to forehead. The appearance will improve with time. An eyebrow graft may be carried out at a later date.



Fig. 3 A



Fig. 3 B

Fig. 3 A. Black pigmented nevus of the shoulder and neck, excised in multiple stages, allowing the skin to relax between stages. Fig. 3 B. The resultant scar may now be excised if desired.

Especially if the excised ellipse has its long axis parallel to the cleavage lines (Langer's lines) of the skin a relatively insignificant scar results.

A more serious problem is presented by the large black hairy moles. These are frequently seen on newborn children and may cover one whole side of the face or a whole extremity (see fig. 2). Naturally they are a matter of great concern to the family. The treatment necessary in most of these cases is their complete excision and replacement by a thick split thickness skin graft. If the lesion involves the forehead and temple regions an attempt should be made to leave all the subcutaneous tissue as a pliable bed for the graft. Time improves the appearance of the graft, but here again the color match is never perfect. Serial excision may be attempted in some of these lesions (fig. 3). If the mole is not too dark and involves the eyebrow and hairline areas, enough of the mole is left in place to furnish an eyebrow and a hairline.



Fig. 4 A



Fig. 4 B

Fig. 4 A. Malignant melanoma. Conservative surgery was decided on after consultation with cancer specialist and pathologist. Fig. 4 B. After complete excision with a wide margin of skin. Note the enlarged node anterior to the ear. (In spite of extensive deep x-ray therapy, patient died 8 months later of metastasis.)

Another serious aspect of moles is their tendency to become malignant (fig. 4). This may occur at any age but most often in the age group of 40 to 70 years. Ackerman and Regato found one case of malignant melanoma for every 35 cases of skin cancer, and

Webster found that malignant melanomas develop on previously benign nevi in 65 per cent of the cases. Malignant melanomas are usually deeply pigmented, superficially ulcerated, very firm and are usually much larger in sections than the appearance of the superficial aspect of the lesion would suggest. They metastasize widely and spread via the blood stream also. Whenever a lesion is suspected of malignancy it should be widely excised with closure or grafting as indicated. A therapeutic lymph node dissection may be carried out if thought indicated. The prognosis varies with the lesion but should always be guarded when the lesion proves to be malignant microscopically.

Here a word of warning is in order. The common practice of removing moles by chemical cauterization or coagulation is to be condemned. Incomplete coagulation or chemical cauterization may furnish just the stimulus to change a benign pigmented nevus into a malignant lesion. Such cases are not rare and moles of 0.5 cm. diameter or more should nearly always be removed by excision for that reason—as well as for the fact that a better cosmetic result can be obtained.

Unightly scars represent a large percentage of the skin lesions requiring surgery. In this age of rapid travel by automobile a large percentage of these are sustained in automobile accidents and sudden stops in which the guest passenger strikes his face on the instrument panel or the windshield (fig. 5). We believe a great many of



Fig. 5. Guest passenger injuries occur four times as often as injury to other occupants of automobiles. These are the commonest modes of injury. (Reproduced by permission of J.A.M.A.)

these could be prevented by taking advantage of the protection offered by a dash pad (fig. 6). The characteristics which cause scars to be unduly objectionable are that they appear: (1) wide, (2) irregular, (3) bumpy, (4) depressed, (5) keloidal, (6) discolored. Unfortunately the cause of most of these objectionable characteristics may be the improper care of the wound at the time of the injury. The proper care of a wound includes the thorough cleansing of the skin and the wound itself, debridement of all devitalized tissue



Fig. 6. A dash pad such as this will help to avoid many facial injuries sustained on the instrument panel. (Reproduced by permission of J.A.M.A.)

including the traumatized wound edges, adequate hemostasis, and a careful layer closure. Fine suture material should be used, and equal bites in the two skin edges is important. The skin sutures should be removed early and further support in the form of flexible collodion or adhesive strips used if indicated.

The removal of scars to be successful must follow certain principles. No scar should undergo surgery until all the inflammatory reaction has subsided. One should take advantage of the natural creases of the skin, and the skin should be incised parallel to the skin cleavage lines of Langer as nearly as possible. Undermining of the skin edges enables one to approximate the edges without tension.



Fig. 7 A



Fig. 7 B

Fig. 7 A. Burn contracture of the axilla and of the breasts. Fig. 7 B. Following Z-plastic to the axilla and skin grafts beneath each breast.

Burn scars present a somewhat different problem. Many scars form contractures or webs across flexion creases fig. (7). The primary purpose of treatment is the improvement of function, and



Fig. 8 A



Fig. 8 B

Fig. 8 A. Burn scars of the hands. Contracture of dorsum of hands causes a great deal of disability in this case. Fig. 8 B. Following excision of the scarred skin and replacement by dermatome skin grafts.

a Z-plastic procedure usually relieves them, though grafts are sometimes necessary (fig. 8). In burn scars involving wide areas of the



Fig. 9 A



Fig. 9 B

Fig. 9 A. Ectropion of lower eyelid caused by burn scar. Fig. 9 B. Ectropion relieved by full thickness graft to eyelid from behind ear. The donor site is easily closed.

face one useful procedure is to excise the scar serially with advancement of the neck skin. The neck skin may be advanced in a period of months up to the malar eminence and onto the base of the nose. This procedure coupled with split thickness skin grafts takes care of most such scars. Full thickness grafts from behind the ears are particularly useful in replacing damaged eyelid skin and relieving ectropia (fig. 9). A persistent ulceration in a burn scar should be suspected of malignancy and should be excised.

Since the effects of x-ray irradiation are progressive, skin damaged by irradiation may first begin to cause trouble after many years (fig. 10). There is usually an initial erythema after which the treatments are forgotten. Months or years later the patient notices the



Fig. 10 A



Fig. 10 B

Fig. 10 A. X-ray damaged skin. Fifteen years following treatment by x-ray for removal of hair. This skin is potentially malignant. Fig. 10 B. Following excision of the involved skin and replacement by a dermatome graft (early postoperatively).

development of a stippled pigmentation of the skin. Later there is peeling and dryness of the skin and a decreased resistance to temperature changes. Even later, sometimes 10 to 15 years after the original x-ray treatments, a definite exematous condition is present and ulcerations appear. These are potential malignancies and should be excised.

The plastic surgeon often sees doctors and dentists who, while using the x-ray, have submitted themselves to excessive x-ray irradiation.

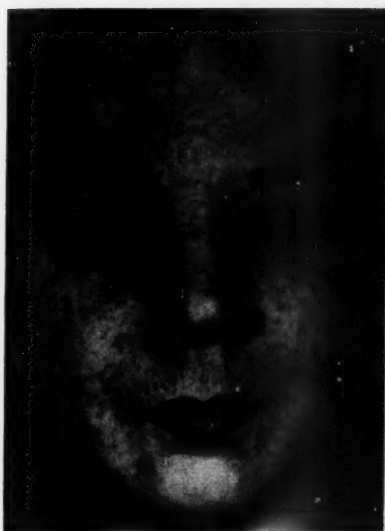


Fig. 11 A



Fig. 11 B

Fig. 11 A. Smallpox pits and scars of 30 years' duration. Fig. 11 B. Following treatment by skin abrasion under local anesthesia.



Fig. 12 A



Fig. 12 B

Fig. 12 A. Side view revealing involvement of the whole face by smallpox scars. Fig. 12 B. The result of treatment by skin abrasion under local anesthesia.

tion. Their fingers frequently need skin grafting if not more radical surgery.

Pock marks, acne pits, and "rough skin" have for a long time been considered afflictions to be borne without complaint, and without hope of relief (fig. 11). These patients, made extremely sensitive and selfconscious by their appearance, are most appreciative of the results we can now achieve.

The principle of treatment is to cause abrasion of the skin of the face, the depth of the abrasion depending on the depth of the lesions. Healing occurs with normal epithelial regeneration so long as only the epidermis is removed and the dermis with its glands and rete pegs of the epidermis remain for epidermal regeneration. The resultant regenerated epithelium tends to be more smooth and level. (See fig. 12.)

Traumatic tattoos occur following automobile accidents (dirt and grease), falls (cinders marks), explosions (powder marks and



Fig. 13 A



Fig. 13 B

Fig. 13 A. Traumatic tattoo of the face following an explosion. The skin has healed and the pigment is deep in the skin. Fig. 13 B. Following treatment of the skin by skin abrasion. Note that all pigment has been removed without leaving any scars of the skin. Local anesthesia was used.

oils). (See fig. 13.) Obviously, excision of the affected skin and replacement by skin grafts is radical and unsatisfactory, and many patients have chosen to keep their disfigurement. In 1946 Iverson reported the use of skin abrasion for this condition. The results are spectacular and we heartily recommend it.

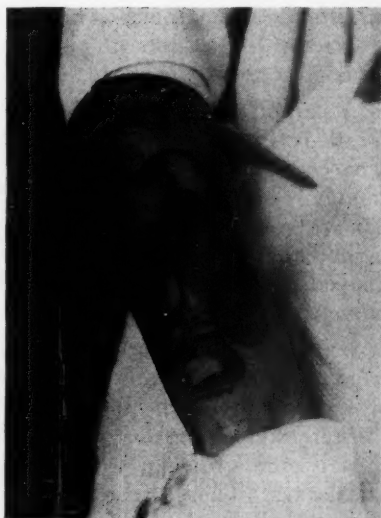


Fig. 14 A



Fig. 14 B

Fig. 14 A. Tattoo of the forearm. Fig. 14 B. Following removal by the dermatome.

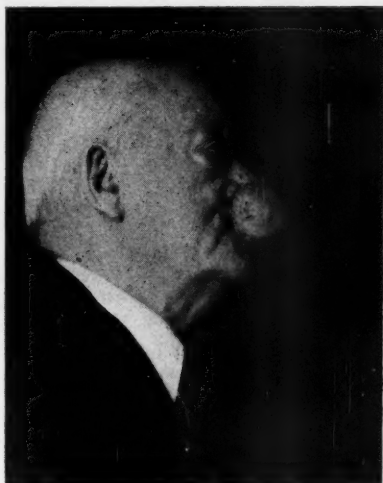


Fig. 15 A

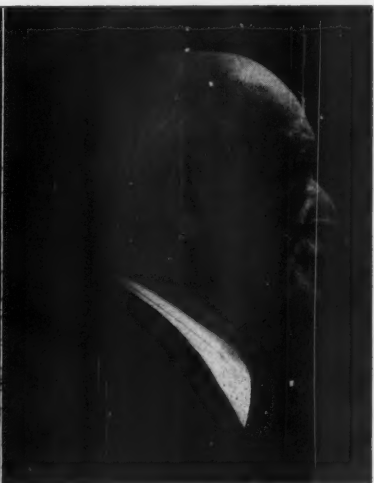


Fig. 15 B

Fig. 15 A. Large rhinophyma with marked deformity of the nose. Fig. 15 B. Following surgical removal under local anesthesia.

Tattoos are best removed by removing a thickness of skin equivalent to a thick split thickness skin graft (fig. 14). It is accomplished

either with a skin graft knife or with the dermatome. This frequently leaves a speckled appearance, and these flecks of pigment are removed tediously one at a time.

A condition which is limited to the skin of the nose and the adjacent cheeks is rhinophyma, the so-called "whiskey nose" (fig. 15). It is a benign hypertrophy of the sebaceous glands developing slowly over a period of years and the etiology is obscure; but the surgical treatment is simple and the results are good. Since the hypertrophied sebaceous glands contain the potential epithelium to re-cover the nose, the excess tissue is removed. After seven to ten days epithelialization is usually complete.

The most common malignancies of the skin are the basal cell carcinoma and the squamous cell carcinoma. The basal cell carcinoma is commonly found on the face above the line from the angle of the mouth to the ear lobe and occurs in fair skinned persons who have had a long exposure to sunlight. It is slow growing, sensitive to x-ray irradiation, and rarely metastasizes. Therefore the choice between surgery and x-ray or radium must be made on the basis of



Fig. 16 A

Fig. 16 B

Fig. 16 C

Fig. 16 A. Defect of the nose, nasal septum and a part of the cheek following complete excision of an advanced basal cell carcinoma. Fig. 16 B. Replacement of the missing tissue by a tube pedicle from the neck. Fig. 16 C. Final result after removal of the tube pedicle and adjustment of the flap.

which will give the best cosmetic result. If surgery is used the lesion as well as a border of normal skin must be removed. However, by undermining the skin edges and approximating the wound as described above a thin line scar is obtained. If irradiation is used no tissue is wasted so to speak, but there is frequently a pock mark remaining at the site, and a slight discoloration and telangiectasia are common. Of course those lesions not responding to irradiation must be excised (fig. 16).

Squamous cell carcinoma occurs more commonly in the lower third of the face than does basal cell carcinoma. It is usually more rapidly growing, varies as to sensitivity to x-ray, and metastasizes to the regional lymph nodes. When it occurs in unexposed areas of the skin it usually arises in old burn scars or chronic inflammatory lesions. The choice between x-ray and surgical excision is made on the basis of its sensitivity to irradiation. In removing these lesions it must be remembered that there is an intradermal spread beyond the apparent limits of the lesion; so a rather wide excision is desirable.

In neglected lesions more radical treatment is required. We have referred some of these cases for chemosurgical excision in order to avoid radical surgery or a very scarring dosage of irradiation. In this way a minimum of tissue is sacrificed by microscopically controlled excision, and cancer cells may be traced along nerve trunks and blood vessels to give a good chance of cure. By conserving all the normal tissue possible the surgical reconstruction is made easier.

In conclusion, I would like to reiterate that skin lesions may be worthy of surgical attention; first, because of danger to health or life, secondly, because of interference with function, and lastly, but by no means of least importance, because of the serious psychological handicaps they may cause.

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THE PORTACAVAL SHUNT IN THE SURGICAL TREATMENT OF PORTAL HYPERTENSION

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PORTAL hypertension has become a subject of increasing concern to the medical profession. This is due in part to the increased incidence of cirrhosis of the liver, secondary to virus hepatitis.

My remarks will be confined to a discussion of the portacaval shunt for the relief of portal hypertension. The term portacaval shunt is employed by us to include any type of anastomosis that joins the portal and caval systems of veins.

Rationale of the Portacaval Shunt

The portal blood pressure in portal hypertension ranges three or more times normal values depending upon the degree of portal bed block, and the adequacy of the collateral circulation.

In portal obstruction, branches of the coronary vein of the stomach inosculating with esophageal veins constitute a most important collateral circuit. The high blood pressure in this circuit causes the development of submucosal varicosities which in time become exposed to trauma, and are prone to rupture.

In cases of portal hypertension, the establishment of an anastomosis between the portal system and vena cava (portacaval shunt) is a rational means of lowering blood pressure in the portal system, and removing the strain upon collateral varicosities wherever they be present. For example, anastomoses of the portal vein itself to the vena cava regularly results in the disappearance of x-ray evidence of esophageal varices. The anastomosis affords a circuit of lowered resistance to blood flow between a relatively high pressure portal system and the caval system.

The Syndrome of Portal Bed Block

Cases of portal hypertension are classified in two groups in respect to the site of obstruction in the portal bed:

GROUP 1. Those having intrahepatic portal block, and

GROUP 2. Those having extrahepatic portal block.

Whether the site of portal block be intrahepatic or extrahepatic, it gives rise to a fairly typical syndrome which is frequently referred to as Banti's syndrome. This syndrome consists of a variable secondary anemia, a leukopenia, a thrombocytopenia, a splenomegaly

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and a tendency to repeated severe gastrointestinal hemorrhage usually associated with ruptured esophageal varices. The spleen shows the pathologic picture of congestive splenomegaly. The liver may be cirrhotic or normal in accordance with whether the site of the portal bed block is intrahepatic or extrahepatic. In our experience with cases having extrahepatic portal block, the site of the obstruction has almost invariably been in the portal vein itself, due to atresia, rarely to cavernomatous transformation and in three instances there was apparently a duplication of the portal vein and its primary radicals with thrombosis.

The Diagnosis of Portal Hypertension

The effects of portal hypertension are often so dramatic as not to make the diagnosis difficult; namely, the history of sudden gastrointestinal hemorrhage with subsequent demonstration of esophageal varices by x-ray. Other cases of congestive splenomegaly may not yet have had a bleeding episode, even x-rays for esophageal varices may be negative. Such cases usually present the secondary anemia, leukopenia and thrombocytopenia of Banti's syndrome, but to differentiate from other splenomegalies, accurate hematologic studies must be done.

Differential Between Extrahepatic and Intrahepatic Portal Block

If a portacaval shunt operation is contemplated for technical and other reasons, it is important to know before operation whether the portal hypertension in a given case is due to extrahepatic or intrahepatic portal block. This differential diagnosis is made upon evidence suggesting the presence or absence of cirrhosis of the liver. If carefully performed blood chemistry and liver function tests point to the diagnosis of cirrhosis of the liver, the block in the portal bed is intrahepatic, otherwise it is considered to be extrahepatic.

Choice of Type of Portacaval Shunt

In our experience the two types of portacaval shunts most commonly used have been the end to side anastomosis of the splenic vein with the left renal vein following splenectomy (splenorenal shunt), and anastomosis of the portal vein to the vena cava, side to side or end to side.

The Portal Vein to Vena Cava Anastomosis Is a Larger and More Efficient Shunt

Since the portal vein blood pressures in our cases of portal hypertension have averaged higher in the intrahepatic block (cirrhosis) group, we prefer to use the portal vein in effecting a shunt. The almost invariable involvement of the portal vein in cases of extra-

hepatic portal bed block precludes the use of the portal vein. This makes the use of the splenic vein the one best hope in effecting a shunt via the left renal vein in this unfortunate group. Though we now have some half dozen cases of extrahepatic block, post splenectomy bleeders who have done nicely employing lesser veins, e.g., the mesenteric or cystic veins, the operations were exceedingly difficult and the chances of success far less than when the splenic vein is available for use. For example, of the 24 cases of extrahepatic portal block in our operated series, 6 cases had recurrence of hemorrhages. In 5 of the 6 cases, lesser veins had been employed, the splenic vein having been destroyed by a previous splenectomy.

Operative Approach

Our favored approach for a splenorenal shunt is through the left diaphragm following resection of the 10th rib, with the patient at a 45 degree angle. For the portal vein to vena cava anastomosis, we much prefer a right thoraco-abdominal approach, resecting the 9th or 10th rib in accordance with the size of the liver.

In view of the operative approach for the two types of portacaval shunt being on opposite sides of the body, and the fact that the portal vein to vena cava type is only possible in cases of cirrhosis of the liver, accurate preoperative diagnosis as to whether the portal bed block is intrahepatic or extrahepatic is much to be desired. I want to say at this point, however, that there is the rare case in which differential diagnosis is exceedingly difficult. When in doubt the operator should plan for a splenorenal shunt. I should like to make passing mention that one should not be too much disconcerted by the unexplained presence of a 2+ or 3+ cephalin flocculation test in cases of portal hypertension due to extrahepatic portal block. The incidence in our series of 24 cases was 6, or 25 per cent.

Figure 1 shows a semi-diagrammatic drawing of some of the important features of the portal vein to vena cava type of portacaval shunt.

A. Illustrates the incision over the 9th rib which extends anteriorly to the midline.

B. Shows a lateral approach to the hepatoduodenal ligament. This is made possible by splitting the diaphragm and everting the liver into the right pleural cavity. This approach was first suggested to me by the work of Drs. John P. Heaney and George H. Humphreys.¹ Note that the completed side to side anastomosis reveals no appreciable angulation of the portal vein. This is an achievement that can be regularly accomplished except in cases with

greatly enlarged livers; in such instances an end to side anastomosis is preferable.

In C note the use of a rubber covered clamp which permits blood flow through the vena cava while the anastomosis is being carried out. The running mattress suture illustrated everts the walls affording intima to intima coaptation.

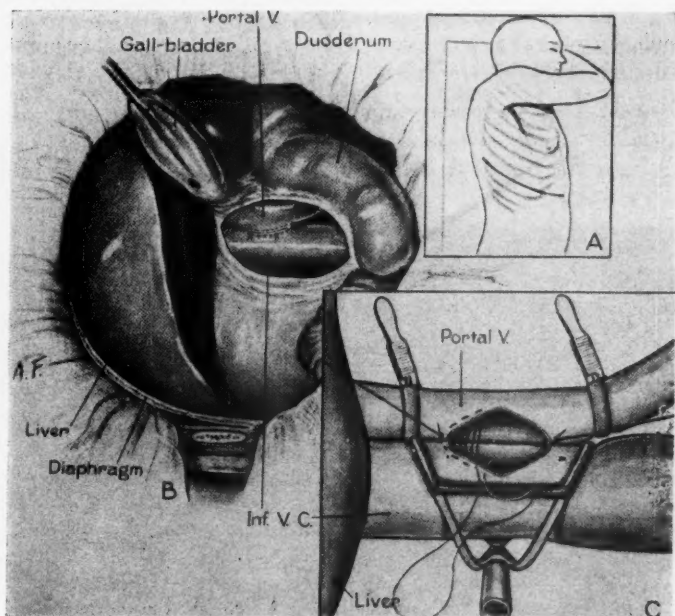


Fig. 1. (A) shows the position of the patient on the operating table with the right side up at a 70° angle. Note the incision over the ninth rib starts slightly beyond the posterior axillary line and continues obliquely downward and forward to cross the right rectus muscle to the midline of the abdomen. (B) illustrates a distinctly lateral approach to the hepatoduodenal ligament. The completed side to side anastomosis of the portal vein to the vena cava is finally covered by suturing the cut edges of the peritoneum with a few interrupted sutures of fine black silk. (C) shows rubber covered clamps in place with the portal vein and vena cava being anastomosed. The posterior half of the anastomosis has been completed employing a running everting mattress suture of #00000 braided silk. The posterior running suture is interrupted by tying to three stay sutures, two of which are illustrated. Note that the transverse incision across the portal vein should extend two or three millimeters beyond the midline. This affords an anastomosis which, when completed, is slightly larger than the cross section area of the portal vein.

Advantages of the Portal Vein to Vena Cava Type of Portacaval Shunt

(1) The portal vein is a husky vein which withstands portal hypertension without showing degenerative changes to the extent

which is frequently encountered in the thinner walled splenic vein—an important factor in a successful anastomosis.

(2) The portal vein because of its large size enables one to establish a shunt of adequate size to reduce portal pressure more nearly approximating normal than can be expected from the employment of the splenic vein.

(3) X-ray evidences of esophageal varices regularly disappear following a portal vein to vena cava type of portacaval shunt—a rare occurrence when the splenic vein is used.

Figure 2 shows esophagrams, left—before— and right—three weeks after a side to side anastomosis of the portal vein to vena cava. Note the complete disappearance of x-ray evidence of esophageal varices.

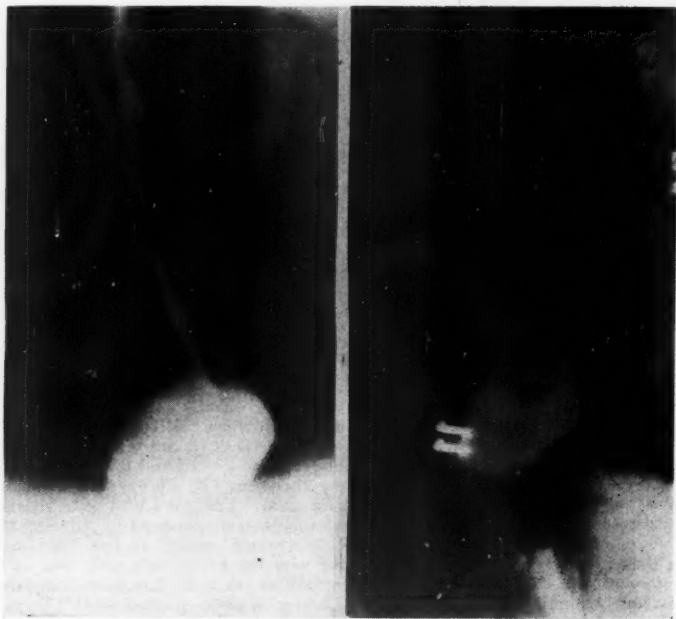


Fig. 2. X-rays of the esophagus following a barium swallow. Left, before operation. Right, three weeks following operation.

(4) The portal vein to vena cava type of portacaval shunt remains patent and prevents recurrence of hemorrhages in a high percentage of cases. In our series of 25 cases employing the portal vein, there has been one failure. In this case the portal vein was 40 per cent occluded by a red thrombus whose surface had not become covered by intima. On the other hand, we have a one year follow-up

on an identical case, except that the thrombus was older and covered with intima. A similar end to side anastomosis has succeeded in this case we know because before operation it was her custom to have hemorrhages at from 10 day to 2 week intervals and there have been none since. Furthermore, nearly every vestige of x-ray evidence of esophageal varices has disappeared in this case. The patient has a shunt comparable to a good sized splenorenal shunt and I believe it will remain patent permanently.

(5) Our experience so far with the portal vein to vena cava type of portacaval shunt would indicate a relatively low operative risk: The loss of three patients (12.5 per cent) in a series of 25 cases, compared to an operative mortality of just under 17 per cent for the 66 cases having splenorenal shunts and 15.5 per cent for the entire series.

Indications for Shunting in Cases of Portal Hypertension Due to Extrahepatic Portal Bed Block

In cases of congestive splenomegaly due to extrahepatic portal bed block, the site of obstruction, in our experience, is almost invariably in the portal vein itself. The splenorenal type of portacaval shunt is indicated. For those patients who have had the misfortune of having the splenic vein rendered unfit for use by a previous splenectomy, an exploration should be done with the chance of using the mesenteric or cystic veins in effecting a shunt. There are occasional cases in which the site of the obstruction is confined to the splenic vein. These cases of congestive splenomegaly can be positively identified at the operating table by making differential portal pressure readings. A normal pressure reading taken from a known branch of the superior mesenteric vein, for example, places the obstruction in the splenic vein itself. Whether the portal hypertension is confined to the congested spleen alone, however, or in addition includes the coronary system of veins, will depend upon yet another blood pressure reading; namely, from a known branch of the coronary vein along the upper, lesser curvature of the stomach. If the coronary vein pressure is elevated to hypertensive levels, one at once knows that the coronary vein joins the splenic vein at a point distal to the constriction in the splenic vein, and a splenorenal shunt is indicated. Whereas, should the coronary vein pressure be normal, the operator knows that in that particular case the coronary vein either joins the portal vein, as it frequently does, or joins the splenic vein proximal to the obstruction and splenectomy alone is indicated.

There is no particular problem in the selection of cases for operation when dealing with cases of portal hypertension due to extra-

hepatic portal block. They are usually good operative risks as is borne out by our series of 24 cases with only two operative deaths.

Indications for Portacaval Shunt in Cases of Portal Hypertension Due to Intrahepatic Portal Bed Block

Much can be said about the selection of cases for shunting in cirrhosis of the liver. To place correct emphasis upon the importance of the selection of cases, preoperative preparation and postoperative handling in the cirrhosis group, I digress at this point to make a few pertinent remarks:

Granted that up to this phase a discussion of the portacaval shunt disposes to confidence in the achievement of technical success and correctly so. But, the facts are that, when dealing with cirrhosis of the liver, the best reward the surgeon can hope for solely on the basis of operative technic, is a postoperative mortality of approximately 50 per cent. At such odds a post mortem view of a patent shunt is indeed a dubious compliment and recalls that time-worn facetious remarks of yesteryears in surgery—"The operation was a success but the patient died."

Aside from the question of surgical technic, a 5 year period of development and clinical application of the splenorenal and portal vein to vena cava types of portacaval shunts in cases of cirrhosis of the liver has taught us that a prohibitive mortality rate can only be avoided as follows:

- (1) Extreme care must be employed in the selection of cases for operation,
- (2) Special preoperative preparation for those patients who need it,
- (3) Extreme care in the avoidance of anoxia and shock during operation,
- (4) Watchful and detailed postoperative handling.

There are many factors involved in the selection of cirrhosis cases for the portacaval shunt. Since the surgeon is held responsible for the outcome of the operation, the responsibility should be his in the selection of cases. Of first importance is a thorough knowledge of the natural history and the vagaries in clinical behavior of the cirrhosis patients. In the evaluation of operative risk, the surgeon must possess skill in the correlation of liver chemistry and function tests with the over-all clinical status of the patient.

It is important to emphasize at the outset that the portacaval shunt operation is not a procedure to contemplate for the emergency control of hemorrhage. Transfusion with the employment of

esophageal tamponage* are the emergency measures indicated for the patient who is rushed to the hospital bleeding from ruptured esophageal varices. With prompt employment of the above mentioned measures the cirrhosis patient can usually be brought out of shock, but what happens to the patient a few days later will depend a great deal upon the functional status of his liver. It is well known that massive hemorrhage seriously depresses the function of a damaged liver and not infrequently precipitates cholemia from which patients fail to recover. Certainly should a patient having cirrhosis of the liver be so fortunate as to survive an attack of hematemesis, every effort should be made to improve his condition in general and his liver in particular pursuant to the evaluation of his status for a portacaval shunt.

The seriousness of hemorrhage in cases having cirrhosis of the liver is well illustrated in a statistical analysis of 124 cases. Dr. Arthur Patek² tells me these patients received the modern medical treatment under especially favorable conditions. The analysis was as follows: the incidence of hematemesis in the 124 cases was 33 per cent, namely, 44 cases. Furthermore, 22 of the 44 patients died of hemorrhage; 50 per cent of them died within one year of the onset of their first hemorrhage. Such statistics on a sizable series of cirrhosis cases well treated medically under ideal conditions certainly confirms the real need for a surgical procedure that will prevent the occurrence of hematemesis. The portal vein to vena cava type of portacaval shunt has proved its efficiency in the prevention of hemorrhage. Furthermore, the operation has been achieved with an operative risk as low as 12.5 per cent.

In view of the above discussion when confronted with a patient with cirrhosis of the liver with proved esophageal varices who has survived one attack of hematemesis, the course of action devolves upon the question of operative risk. If after a thorough clinical appraisal of the patient, including liver chemistry and function studies, it would appear that he is a poor risk, every effort should be expended to improve the functional status of the liver. Deferring the portacaval shunt operation to attain an improved status of the liver should distinctly take precedence over the likelihood of an intervening hemorrhage. The above principle should be adhered to

*The Davol Rubber Co. of Providence, R. I., manufactured under our direction a special nasogastric tube with balloons attached. This device, first employed by us in 1946, has proved efficient in the control of hemorrhage from esophageal varices. The tube is well tolerated by the average patient because of a special design of the esophageal balloon to prevent traction upon the nasogastric tube after inflation of the balloon. This was accomplished by increasing the thickness of the rubber in the distal end of the balloon.

though a tendency to bleed incur the necessity of keeping an esophageal balloon in place over long periods of time.

A recent case in point is that of a 55 year old man with portal cirrhosis who required balloon tamponade off and on over a period of seven weeks. During much of the time he bordered on a state of cholemia. On admission he was deeply jaundiced, had ascites and peripheral edema. His serum albumin was 2.3 per cent, serum bilirubin 12 mg. per cent, alkaline phosphatase 17 B.U. per cent, cholesterol esters but 12 per cent of the total, bromsulfalein retention $\frac{1}{2}$ hour after injection was 55 per cent, galactose removal constant 2 (50 per cent of normal). Subsequently, as evidence of recurring active hepatitis, the patient would have gastrointestinal upsets, febrile episodes and a persistent 4 plus cephalin flocculation with "flare-ups" in his jaundice. At the end of seven weeks the nasogastric tube bearing the balloon was removed. Over the ensuing four weeks, the patient had three minor bleeding episodes, consisting of tarry stools, which were controlled by transfusions. Though the patient began to improve slightly at the end of four months, his jaundice continued deep and attacks of vomiting persisted.

Rather suddenly four and a half months after admission, the patient stopped vomiting and developed a voracious appetite. Thereafter he improved rapidly in strength and began to gain weight. Though his cephalin flocculation remained 4 plus, his serum bilirubin gradually fell to normal.

At the end of five months in the hospital, the patient's cholesterol esters had risen to 40 per cent of the total, but the bromsulfalein retention had improved but little (50 per cent $\frac{1}{2}$ hour after injection). The serum albumin had risen to 3 gm. per cent, the alkaline phosphatase had returned to normal. At this point the question of proceeding with a portacaval shunt operation was seriously considered but was postponed for the following reasons: (1) Whereas certain of his liver chemistries had improved markedly, it was thought that to operate at this time would involve a 25 per cent or more risk. (2) The patient's general physical condition was improving so rapidly it was thought that in two or three months his liver would be further improved to the point that he could be operated upon at a reduced risk.

The case cited above is to illustrate the most extreme depression of liver function with persistence of bleeding in our experience not to have ended with cholemia and death. Though none of the several prothrombin determinations were more than 23 seconds (compared to our standard normal at 18 seconds), the patient's tendency to persistent seepage of blood during the period of most marked liver decompensation was convincing evidence of the importance of hypoprothrombinemia in this case. It is true there were demonstrable esophageal varices as evidence of portal hypertension, but they were small in size and it was thought that perhaps the portal hypertension may not have been so high as to make it the most dominant element in the persistence of bleeding in this case. Further in support of this, it was noted that fresh bleeding from the esophageal varices usually ceased when the esophageal balloon was inflated with as little as 15 mm. of mercury pressure as compared to 25 to 25 mm. of mercury pressure required in the average case.

Having demonstrated esophageal varices by x-ray on this man, on a statistical basis we may predict with a large degree of certainty that as the periportal fibrosis increases the rising portal blood pressure will cause recurring hemetemeses. Nevertheless this is likely to take some months and in the meantime, under an energetic treatment regimen, the man's liver may have improved to the point that the shunting procedure can be carried out with minimal risk.

I have cited this case of cirrhosis having his first hemorrhage to emphasize the importance of the likelihood of clotting derangement due to hypoprothrombinemia secondary to liver failure as playing a major rôle in the first hemorrhage of patients having cirrhosis of the liver.

In our experience, the majority of the cirrhosis patients who first present themselves in liver failure will respond favorably and reasonably promptly to conservative handling, whether their major problem be that of hemorrhage or ascites or both. After liver compensation is restored, there is usually adequate time to evaluate and observe further progress before setting a date for a shunting operation.

The question may properly be asked at this point: When is such a case good operative risk? One can best answer this by again referring back to the case whose progress up to the fifth month of illness has been cited as follows: Should the patient continue to gain in weight and strength, the cholesterol esters rise to as much as 60 per cent of the total, the galactose removal constant rise to 3, the brom-sulfalein retention to as little as 25 per cent one half hour after injection, then the patient may be considered a good operative risk.

Our experience indicates a greater likelihood of portal hypertension being the sole causal factor in recurring hemetemeses in cirrhosis. There are patients who give long histories of bleeding attacks, others in whom hemorrhage recurs in such rapid succession as to make the risk of death from hemorrhage far exceed that of operation. The above is borne out by the operative results in 15 such cases in our series in which there were but 2 postoperative deaths. Many of these cases from a liver function point of view qualify as excellent operative risk. Over and over again in the history the familiar story is told of an initial symptom of a failing liver which led to the diagnosis of cirrhosis, great improvement following the institution of treatment, and then suddenly, one year or two years or even four years later, hemetemeses, the result of increasing periportal fibrosis. In this sizable group of cirrhosis cases there has been time for liver cell regeneration with restoration of adequate liver function. They are usually good operative risk, and such patients may live active lives for years following the establishment of a portacaval shunt.

When Is Ascites an Indication for the Establishment of a Portacaval Shunt?

It is becoming better known that ascites may be made to disappear in the majority of cases of Laennec's cirrhosis following the institution of a proper medical regimen of therapy. Response to treatment may be extremely slow (10 to 12 months) and in some cases, I am told, require in addition limitation of the daily sodium intake to as low as 1 gram for months to clear the ascites.³

The wide variations in the response of ascites to treatment has brought forth a consideration of three possible influencing factors, namely:

- (1) Serum albumin blood level,
- (2) The presence of an antidiuretic substance which promotes the retention of sodium,
- (3) Portal hypertensive factor.

The frequency with which cases of cirrhosis get rid of their ascites *para passu* with a rise in serum albumin during treatment, and the same effect following the intravenous administration of human albumin on occasion, has been convincing evidence to most of us in the past of the importance of the rôle of the serum albumin level in the regulation of ascites. We can point to well documented cirrhosis cases in our series which would seem to make a clear presentation of both the rôle of serum albumin and portal hypertension as it affects ascites. For example: patients who were relieved of ascites when under treatment, their livers having regained the ability to raise the serum albumin level to 3 or more grams per cent. The same patient to have recurrence of ascites following a rise in portal hypertension as evidenced by the subsequent appearance of x-ray evidence of esophageal varices. Furthermore, correction of the excessive portal hypertension following the establishment of a portacaval shunt in such cases has been regularly followed by disappearance of the ascites. This would seem to indicate that, as long as the liver can function sufficiently to maintain a serum albumin level above tissue edema level in cases in which a shunt is present to regulate portal blood pressure, ascites will not form.

In recent years considerable evidence has been amassing to indicate the importance of the rôle of sodium retention in ascites and edema as effected through an antidiuretic factor. It is hoped that soon much more of practical significance will be learned. Until such time, extreme caution must be exercised in the selection of cases of ascites for the shunting procedure. This is particularly true in patients who have an unusually low urine sodium which is influenced little if any by injections of mercurhydrin.

The above discussion does not mean that we have not operated upon patients with ascites. As a matter of fact, the longest follow-up case (4½ years) that we have living in the entire series of cirrhosis cases was that of a man with severe ascites who gave no history of hemetemesis. This man gained 50 pounds in weight the year following operation and return to an active job. There is another patient with an equally brilliant record: A woman whose weight increased from 80 pounds to 120 pounds over a year's period following operation. And finally, there are a fair number of patients operated upon who had ascites and also gave a history of hemetemesis before operation.

Correlation of Liver Function Tests in the Evaluation of Operative Risk

An analysis of many cases of cirrhosis of the liver in which portacaval shunt was established affords some opportunity of correlating the preoperative evaluation of the status of the liver with its postoperative behavior. It became early apparent in the series that no single liver test employed by us afforded consistently adequate information upon which to predicate the behavior of the liver postoperatively.

To present an overall perspective of the relative values of the different liver tests employed in terms of postoperative behavior of the liver, I have selected seven cases who presented unmistakable clinical evidence in their postoperative convalescence of further depression of liver function. Figure 3 shows the preoperative liver studies and postoperative comments on the seven cases. The occurrence of ascites in a case whose portal hypertension has been relieved by the establishment of a shunt is interpreted by us to mean unmistakable evidence of depression of liver function.

The array of liver studies in the different cases impresses one of the importance of no single test to the exclusion of others. This is best illustrated by the cephalin flocculation reaction which is strongly positive in four cases and totally negative in three. A positive cephalin flocculation test is taken by many observers to mean active liver damage. To us it has served as a warning of the possible presence of hepatitis. Each of the four patients having strongly positive cephalin flocculation tests were jaundiced. The cirrhosis was considered to be secondary to virus hepatitis in the cases having strongly positive reactions, and the three cases having a negative test are considered to have Laennec's cirrhosis.

Any positive advantage of the negative cephalin flocculation reaction in Cases V, VI, VII, would seem to be offset by the marked

impairment on the part of the liver to excrete bromsulfalein and the extremely low serum albumin percentage when compared with Cases I, II, III and IV.

NUMBER	LIVER CHEMISTRY (PREOPERATIVE)	COMMENT (POSTOPERATIVE COURSE)
I DURCAN (767171)	CEPH. FLOC. = 4+, SERUM ALB. = 2.9%, GLOB. = 3.7, S. BILIRUBIN = 2.7 MG.%, SERUM PHOSPHATASE = 9.5 B.U.%, BROM- SULPHALEIN RETENTION $\frac{1}{2}$ HR. = 70%.	ANOREXIA, WEAKNESS, TEMPORARY RECURRENCE OF ASCITES.
II SCHWIM- MERTEN (850896)	CEPH. FLOC. = 3+, SERUM ALB. = 3.3%, GLOB. = 5.2%, S. PHOSPHATASE = 10.7 B.U.%, S. BILIRUBIN = 1.9 MG.%, HIPURIC ACID EXCR. = 0.6 GM., BROM- SULPHALEIN RETENTION $\frac{1}{2}$ HR. = 42%	ASCITES REAPPEARED RE- QUIRING ONE PARACENTESIS. WOUND DISRUPTED.
III AERAMS (868165)	CEPH. FLOC. = 3+, SERUM ALB. = 3.5%, GLOB. = 2.9%, S. PHOSPHATASE = 6.1 B.U. %, S. BILIRUBIN = 1.8 MG.%, BROM- SULPHALEIN RETENTION 45 MIN. AFTER INJECTION = 23%. PROTHROMBIN TIME 50% OF NORMAL	ASCITES REAPPEARED TRANSITORY.
IV HUBIC (900615)	CEPH. FLOC. = 4+, THYMOL TURBIDITY = 4+, SERUM ALB. = 3%, GLOB. = 2.9%, S. BILIRUBIN = 3.6 MG.%, SERUM PHOSPHATASE = 3.9 B.U.%, GALACTOSE REMOVAL CONSTANT = 2.1, BROMSULPH. RETENTION 45 MIN. = 37%. PROTHROMBIN TIME 60% OF NORMAL.	ASCITES OCCURED ON 3RD POSTOPERATIVE DAY REQUIRING ONE PARA- CENTESIS.
V JACOLETTI (784905)	CEPH. FLOC. = NEG., SERUM ALB. = 2.9%, GLOB. = 2.3%, SERUM PHOSPHA- TASE = 3 B.U.%, BROMSULPHALEIN RE- TENTION $\frac{1}{2}$ HR. = 35%.	ASCITES RECURRED AND PERSISTED FOR SEVERAL MONTHS, FINALLY DIS- APPEARING AS THE SERUM PROTEINS ROSE.
VI SALMON (817310)	CEPH. FLOC. = NEG., SERUM ALB. = 3%, GLOB. = 2.3%, S. BILIRUBIN = 2.5 MG.%, S. PHOSPHATASE = 4.6 B.U. %, BROMSULPHALEIN RETENTION $\frac{1}{2}$ HR. AFTER INJECTION = 40%.	ASCITES REAPPEARED BUT PROVED TRANSITORY. BE- CAME MORE JAUNDICED FOR A WEEK POSTOPERATIVELY.
VII LONG (783972)	CEPH. FLOC. = NEG., SERUM ALB. = 2.3 %, GLOB. = 3%, S. PHOSPHATASE = 10.2 B.U.%, HIPURIC ACID EXCRE- TION = 0.6 GM., BROMSULPHALEIN RE- TENTION $\frac{1}{2}$ HR. = 40%.	ANOREXIA, WEAKNESS. RECURRENCE OF ASCITES REQUIRING ONE PARACENTESIS ON 8th POST OP DAY.

Fig. 3. A table showing the preoperative liver chemistry and postoperative comments upon 7 cases of severe cirrhosis of the liver.

In summary we may say that the liver evaluation tests showed throughout the most impairment in Case IV, and by all odds, she had the stormiest postoperative course with the exception of possibly Case V.

The inability on the part of the liver to make adequate amounts of albumin and excrete bromsulfalein were the most consistent findings throughout the series of seven cases. The quickest postoperative deaths from liver failure in our experience occurred in two patients, each of whom preoperatively had a serum albumin level of 2.4 per cent. One of the cases had a deep unremitting jaundice

and the other had a bromsulfalein retention of 40 per cent one half hour after injection.

Our experience in general would indicate that cases having a serum albumin level consistently under 3 per cent with bromsulfalein retention in excess of 35 per cent one half hour after injection are not good operative risks. Cases of post hepatitis cirrhosis in the above category would, however, in our opinion, have a wider margin of safety.

Preoperative Preparation of Cases of Cirrhosis for Portacaval Shunt

The average cirrhosis case will do best with a 10 day to 2 week period of intensive feeding immediately prior to operation. It is important that he have a good appetite and demonstrate his ability to gain weight during the period. Vitamins, including B complex, are used to advantage. It is most important to see that anemia is corrected, including bringing to normal his circulating blood volume and cell mass by transfusions when necessary.

At operation the best possible protection to the liver is afforded by the avoidance of anoxia and shock. The above is best achieved in our experience with well administered cyclopropane anesthesia, careful hemostasis and the avoidance of blood pressure recessions by adequate blood replacement throughout the operative procedure. To avoid the chance of overtransfusion, it is our custom to take an hematocrit reading at the time of performing the anastomosis.

Postoperative Care

To minimize as far as possible the depression of liver function postoperatively, again steps are taken against anoxia as follows: Oxygen tent, frequent blood pressure determinations and hematocrits to indicate further administration of whole blood or plasma.

Careful regulation of the electrolytes based on daily blood analysis until the patient is taking fluids by mouth adequately. Measuring urine output and sodium determinations on the urine are desirable, the latter a necessity in ascites cases. In this period, up to 100 grams of glucose daily is administered parenterally as well as adequate vitamins. Large doses of liver extract are given every other day. On the third postoperative day, a blood urea and the following liver chemistries are done: serum bilirubin, albumin, globulin, phosphatase and cholesterol partition.

A general principle is to get the patient eating as soon as possible. This has best been achieved in our experience by preventing as much as possible the occurrence of abdominal distention as follows:

(1) Prostigmine and rectal tube at 4 hour intervals until a bowel

movement results (usually in 2 to 3 days). (2) Early mobilization (day after operation in suitable cases). Water and tea are given in small amounts until the night of the first postoperative day, when gruel is added. Often on the second postoperative day the patient can handle a selected soft diet including 2 tablespoonfuls of a protein hydrolysate (Protinal) in a glass of milk t.i.d. Thereafter the diet is rapidly expanded to a high carbohydrate and protein intake.

As a word of caution, one should see these patients twice a day for a week or ten days postoperatively and have liver chemistries repeated on the sixth postoperative day. Extreme care must be taken against over exertion, and bad risk cases should not be mobilized early.

Postoperative Mortality

The portacaval shunt procedure has been accomplished by us 91 times with a postoperative hospital mortality of 14 cases, or 15.5 per cent, as follows: 24 cases of Banti's syndrome due to extrahepatic block, 2 deaths (8.4 per cent); 67 cases of portal hypertension due to intrahepatic block (cirrhosis), 12 deaths (18 per cent). In 25 of the 67 cases of cirrhosis of the liver, the portal vein to vena cava type of portacaval shunt was carried out with a loss of three patients postoperatively. The causes of death were as follows:

Cholemia or liver failure, 3 cases (one complicated by lenticular degeneration [Wilson's disease]).

Cardiac, 2 cases (one coronary occlusion, one failure due to arteriosclerotic myocardial fibrosis).

Internal carotid artery thrombosis, 1 case.

Shock, 5 cases (one from unsecured, torn mesenteric vein, one from hemorrhage at operative site, one from intraperitoneal hemorrhage at undetermined site, one from unrecognized bleeding peptic ulcer, and one from bleeding varices complicated by laryngeal obstruction). Heparin was employed postoperatively in the latter case only.

Finally, mesenteric thrombosis was considered to be the predisposing cause of death in the remaining three of the fourteen cases. In one case there was a septic thrombophlebitis which started in the middle hemorrhoidal vein and finally ascended to the portal vein via the inferior mesenteric vein. A *Salmonella Montivedeo* organism was recovered.

Follow-up Results

Of the 22 cases having extrahepatic portal block followed, two

are dead of recurring hematemesis. The splenorenal shunts were closed in each instance. One case, a child of two years of age, lived one and a half years following operation. The other, a girl of fifteen, lived two years and nine months following operation. One other case having a splenorenal shunt in this group has had one episode of hemorrhage since operation, and we must suspect the shunt may be closed. Of the 5 remaining cases that have had one or more bleeding episodes, the shunts may well be inadequate, for in all five of these a previous splenectomy had precluded the use of the splenic vein and lesser veins were used in effecting shunts. It is illogical that these small shunts should give full protection against hemorrhage even should they all remain open. The important thing is for surgeons to stop contributing to the size of this group of unfortunates by failing to use the one good vein available, namely, the splenic vein, at the time when splenectomy is done.

Of the 55 cases of portal hypertension due to intrahepatic portal block (cirrhosis) followed, 9 are dead, all except one of liver failure. They lived for varying periods of two years to four years post-operatively, except one who died some six months following operation. Gastrointestinal bleeding was present in their final hours of terminal liver failure in three cases. There is little doubt that terminal hypoprothrombinemia was a factor in hemorrhage, since the splenorenal shunt was proved patent in two. In one of these cases, the common duct was found to be plugged with calcium bilirubinate stones at necropsy.

A second shunt, portal vein to vena cava anastomosis has been established in two cases, and since the second operation not only have there been no hemorrhages but all x-ray evidence of esophageal varices has disappeared.

At present, I know of only two of the remaining forty-six cases being followed, who are not reasonably active, and one of these is slowly but steadily improving. Many of the patients have jobs and earn their livelihood. Liver function studies on most of the patients are remarkably good. Some of the tests in a few have shown a decline, whereas just the opposite has occurred in some others. The follow-up ranges from 4 months to 4½ years after operation.

In retrospect, we realize that some of the causes of our post-operative deaths may be avoidable in the future. On the other hand, we equally well realize much more is yet to be learned, particularly in respect to the selection and handling of ascites cases. Though the results in this small series leaves much to be desired, there is honest satisfaction from detailed knowledge of individual cases that many who survived the operation are now alive because of it.

SUMMARY

Attention is drawn to the increased incidence of portal hypertension largely on account of the present prevalence of cirrhosis of the liver secondary to virus hepatitis.

The rationale of the portacaval shunt for the relief of portal hypertension is presented.

Portal hypertension cases are classified into two groups in accordance with the location of the site of obstruction as follows: (1) Intrahepatic, which includes cases of cirrhosis of the liver; (2) extrahepatic, those cases in which the obstruction is outside of the liver in the portal radicals. Whether the obstruction be intrahepatic or extrahepatic, it gives rise to a fairly typical syndrome commonly referred to as "Banti's syndrome."

The types of portacaval shunts commonly employed are discussed with particular regard to choice of procedure.

The selection of cases for operation is discussed, particularly in respect to cirrhosis cases.

The necessity for preoperative preparation in certain cases is stressed. The importance of preoperative blood volume and electrolyte studies are emphasized to be certain that cases come to the operating table with a normal red blood cell mass and an evaluation of their ability to excrete sodium.

The necessity of good anesthesia and the avoidance of shock during operation are discussed.

Postoperative handling is discussed.

The results following the establishment of portacaval shunts in 91 cases of portal hypertension are discussed.

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THE DIAGNOSIS OF CANCER BY SMEAR TECHNIC

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I APPRECIATE very much the privilege of speaking to you today. The subject is not my selection, but that of your secretary, Dr. Beasley, who suggested it when he invited me to address the Congress. A pathologist welcomes an opportunity to speak to surgeons, for both specialties are very closely related, and close cooperation and understanding between surgeons and pathologists are most desirable. I agreed with Dr. Beasley that this is a very timely and important subject, for there is considerable misunderstanding, even confusion, throughout the medical profession and the lay public. The comparatively recent developments in methods of exfoliative cytologic diagnosis and the rather unfortunate publicity in the lay press make it most important that the medical profession understand this method of smear diagnosis, its possibilities, particularly its limitations, and the actual hazards involved in the attempted diagnosis of cancer based upon single cells or at most small groups of cells in the spreads of material. This discussion is presented with the hope that you will have a better understanding of some of the problems involved and that, through you, your patients will not expect the impossible from an examination which at present must be considered as a preliminary one and not a means of absolutely definite and final diagnosis.

After the facts have been stated and points proved, statistics become uninteresting and less important. Therefore, I will not bore you with quotations of statistics from various clinics and laboratories. In the past few years, the medical literature has contained numerous reports of rather large series of examinations of smears from the vagina, cervix, bronchi and other organs. Many of these reports have been quite constant and comparable in their findings for similar organs and technic, while in others there has been less uniformity.

As with new or revived methods of experimentation and diagnosis, many of these reports were statistical, and their purpose was to prove the value and suitability of this method of diagnosis, which as a routine method was quite different from the usual diagnosis by biopsy and the study of stained sections of fixed tissue. I am quite sure that these studies seem to prove the value of the method and that it has a very definite place in cancer diagnosis. The percentage of accuracy of smear diagnosis as proved by subsequent biopsy or

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operation may be set at about 90 per cent in positive cases and about 80 per cent in negative cases. False negatives run a little higher than false positives and present a rather serious problem. In the beginning, some investigators were pessimistic and destructively critical, and many were actually antagonistic. Some still are, but most are definitely willing to pursue a conservative and middle-ground course, with an open mind, which we should all do, not only considering the possibilities but at the same time realizing the limitations and difficulties involved.

Diagnosis by means of smears is not new. Malignant cells in exudate were demonstrated and described nearly 100 years ago, and for years pathologists have been requested to examine body fluids and exudates for the presence of tumor cells. This has never been a simple procedure, for the variation in the appearance and arrangement of mesothelial cells in exudates and transudates makes differentiation from neoplastic cells quite difficult and frequently impossible.

Nor is the examination of direct smears from tissue new. Smears of biopsy material removed by surgical or aspiration methods have frequently offered the first and perhaps the only opportunity of definite diagnosis. Biopsy of lymph nodes is usually relied upon for diagnosis of tumors of lymphoid tissue, either lymphoma or metastatic lesions, by critical study of the cells of nodes in sections. However, smears of lymphoid tissue stained with Wright's or Giesma stain present a beautiful appearance and a picture difficult to obtain in sections of fixed tissue.

Papanicolaou¹ made his first report 20 years ago, but the actual development of diagnosis by means of smears dates from the publication of the monograph by Papanicolaou-Traut² on the "Diagnosis of Uterine Cancer by the Vaginal Smear" in 1943. Papanicolaou³ speaks of this as a "revival," realizing that the basic principles were not new. From that date to the present, there has been an increasing number contributing to our knowledge of this method of diagnosis, not only Papanicolaou and Traut, but Meigs, Warren and Gates, Ayre, Foot, and Pund, just to mention a few who have pursued this investigation with a relatively large volume of material and who have been a stimulus to many others. There have been modifications in technic of preparation and staining, but the principles remain essentially the same.

Unfortunately, many have the idea that the Papanicolaou technic is a specific diagnostic stain for cancer. There is a tremendous lack of understanding about this method, and smears and fluids are frequently received with definite instructions that the Papanicolaou

stain be used. The choice of staining technic should be left to the discretion and choice of the pathologist, for he may prefer other types of stains. The numerous articles in the lay press, both newspapers and particularly women's magazines, have caused an increasing number of patients voluntarily to ask for this type of examination. One magazine described it as "an inexpensive, painless and 97 per cent accurate" method of cancer diagnosis. If the examination is reported as negative, patients have a false sense of security. They feel that they not only do not have cancer, but some even feel that they can never have the disease. Just because no suspicious cells are found in the smears, it does not mean conclusively that there is no cancer present, nor does it mean that cancer might not be found the very next day,¹⁴ the next week or the next month. A negative report simply means, "not found," the same as a sputum reported negative for acid-fast bacilli. The Papanicolaou stain gives a beautiful smear if done with careful technic. The transparency and variation in color reaction cannot be duplicated with other stains, and the stage of cell differentiation is very striking, as well as the effects of hormones on the cells. But for simple staining of cells so that the size, shape, cytoplasmic features and nuclear variations can be seen, many stains are perfectly satisfactory. Many are using and have reported hematoxylin and eosin^{4,6,7} as particularly suitable, as well as Wright's stain⁵ and Geisma stain.⁶ The cells are well stained and clear and of diagnostic quality. I use hematoxylin and eosin particularly with bronchial washings and really prefer it to the Papanicolaou stain for this material.

We must remember that there is no specific stain for cancer. We can only wish that there were such a differential stain, for many problems would be greatly simplified. For years, the search for a specific stain has gone on and it may yet be found, but so far we have not come close to it. We do have stains which will differentiate types of cells and tissues, but no dye has yet been found which will differentiate a benign cell from a malignant one of the same tissue type. Some 25 years ago Bloodgood⁸ set up part of his laboratory to work on this problem, and I am sure that he was sincere in his feeling that a specific stain would or could be found. He even went so far as to state that when the specific stain for cancer was found, the pathologist would lose his job unless he was an operator as well! At the present time, all pathologists are working, none have applied for unemployment benefits, and the need for more pathologists is still extremely acute, to fill even a small part of the available openings. When and if the specific stain is found, it will be a tremendous step forward in the solution of the cancer problem. As one writer has expressed it, "No staining technics so far developed

can replace the skill and judgment in interpretation required of the pathologist."⁵ That applies not only to smears but to sections of fixed tissue as well.

There is another important point in the consideration of diagnosis by means of smears. In many instances, this is being done by those who are not qualified by training or experience to interpret cell types and variations found in smears. I personally know of surgeons, gynecologists and even internists who would not attempt to make a diagnosis on a stained section of fixed tissue, yet who do not hesitate to examine and interpret the greatly varied and bizarre cell forms found in smears. I recall one patient who was told that a single malignant cell was found in the smear from her cervix. Perhaps it was there, but I was not able to find any cell that was even suspicious to me. This patient and her family were greatly upset, and she will always be wondering about whether or not she has cancer.

A very dangerous practice is that the examination of smears is too frequently left in the hands of inexperienced technicians, those who are entirely untrained and whose only experience in cytology is probably in blood counts and differential smears. Pathologic cytology cannot be learned overnight, although there are those who think that cell differentiation can be mastered in a few weeks' time. It is true that much of the screening in large and active laboratories is done by technicians, but they have had long training under close supervision. A technician should have at least 6 months of intensive training before being considered even "fairly good." I would warn the inexperienced from attempting the use of the smear method of diagnosis. It is so frequently difficult for even the experienced pathologist, and the difficulties are greatly increased and even insurmountable to one who does not know the cytologic differences of various types of cells, some normal, some altered by functional or inflammatory disturbances, and others actually neoplastic.

The smear method is time-consuming for both technician and pathologist. After the smears are prepared, usually 2 to 4 smears per individual case, the average time of examination of the smears should be from 10 minutes up to 2 hours. Some say 5 minutes to 1 hour.¹⁰ By experience, one can dispose of obviously negative smears in a few minutes, but suspicious or doubtful cases require much more time and frequently repeated smear examinations. On the other hand, a recent report states that 5 smears are examined on each case, 30 minutes to each smear, unless malignancy is demonstrated sooner. That means two hours and a half on most cases before being pronounced negative. A good average would be from 10 to 16 smears

for an eight hour working day, which would leave little or no time for other pathologic work. The patient and the average doctor do not realize that the cost must be relatively high, even higher than that of the average biopsy examination. The time factor, the need for trained personnel, and the cost to the patient, have caused some hospitals and clinics to abandon smear diagnosis as a routine procedure. Any institution with a significant amount of cytologic diagnosis will of necessity have to have someone devoting his entire time to this, for the average hospital pathologist is already burdened with the examination of surgical and autopsy material. It is easily seen what a problem it would be if there were a concerted attempt to screen the entire female population. It has been estimated that two technicians and a pathologist devoting at least half of his time to smears alone could do not more than 150 cases in one week!

While most of the work reported has been on smears of vaginal and cervical material, this method is being increasingly used in the investigation of tumors of other organs. Bronchial secretions are frequently examined and reports are becoming more numerous on the examinations of smears from the stomach, kidney, prostate and intestinal tract. However, the results on the latter are not as yet as satisfactory nor as convincing as those in cervical and uterine cancer. I would be hesitant to use the smear method for suspected carcinoma of the prostate, for one must massage the gland¹¹ in order to obtain material for examination, and massage or rough handling of any organ suspected of containing a malignant tumor is definitely contrary to our knowledge and teaching of handling of cancer. For prostatic disease, I believe that aspiration biopsy would be much safer, and I have had very satisfactory results with aspirated material.

It has been stated by many investigators that the smear method should not be considered a means of *final* diagnosis.³ I am sure that there is almost complete agreement on this. In only rare instances have radical therapeutic measures been performed on a basis of the diagnosis on smears alone. Positive or suspicious smears should be further investigated and whenever possible confirmed by biopsy by acceptable methods and study of sections of fixed tissue. In some cases, suspicious smears cannot be confirmed for some time, even with repeated biopsy. On the other hand, biopsy may be entirely impossible. It is this latter type of case which will make smear diagnosis so important, when tumors of the Fallopian tubes, lungs, kidney, brain and other organs inaccessible for biopsy can be repeatedly and accurately diagnosed on the character of a few cells in fluid or smeared from an applicator. Then this method of cancer diagnosis will have reached its full value.

Whenever sufficient material is obtained, particularly in washings from the bronchi, stomach, etc., it should be centrifuged and the material fixed and embedded in paraffin and sections examined as usual.^{12,13} In this way, the preparations will be thin, without overlapping of the cells, and the relations of cells to cells, which is quite important, can be determined. When material is not abundant, in addition to smears, sediment may be soaked up in gel-foam or other suitable spongy material, and embedded as a sort of biopsy specimen. Results are rather frequently surprisingly good with this method, which although only comparatively recently reported,¹⁵ has been used for quite some time. Gel-foam may be used as a sponge to rub lightly over an erosion or ulcer and then treated as a biopsy specimen.

Still another difficulty lies in the fact that there is no single criterion for the diagnosis of cancer in smears, and criteria vary in material from different locations. Repeated smears from the same patient may and frequently do show widely varied pictures. The diagnosis is based upon general cell changes in size and shape and cytoplasmic volume, and particularly changes in nuclei. Mitoses, looked upon by so many as a sign of activity, and by the inexperienced as a definite indication of malignancy, are rarely seen in exfoliated cells,² unless from a deeply ulcerating lesion. However, they are rather frequently seen in histiocytes and mesothelial cells. To be considered as evidence of malignancy, the mitotic figures should be of an abnormal type. A large nucleolus is contributory evidence. In fact, some twenty years ago,⁹ cancer was reportedly diagnosed on a single unstained cell, chiefly on the character of the nucleolus. Of course, if clumps of cells are found, the actual relationship of one cell to another is very important.

The lack of care in securing material may prevent satisfactory or even any examination. Even smearing material on the slide and immediate fixation require care. Prompt fixation is desirable in ether-alcohol mixture, but it is surprising how good some results are on dried-out smears. Securing material for smears should be done under direct observation. I have found that some do not even visualize the cervix in obtaining smears and that it is done absolutely blindly. Of course, there are some locations where this is impossible, and allowance must be made for this, but it is surprising how carelessly the procedure is done. Some seem to think that anything on a slide is all right to pass on to the pathologist. The smear should contain sufficient but not an excess of material. Attempted diagnosis on inadequate material, carelessly secured and poorly handled, is hazardous, difficult and very frequently impossible.

For some time I was just about as skeptical of diagnosis based on

smears as anyone could be, and I was most reluctant to use it. But like so many others, I was practically forced into it. Examination of negative smears grew rather monotonous, particularly with scanty material and poorly prepared smears. But an occasional positive smear of cervix or bronchus did arouse interest, and I would like to show you photographs and photomicrographs of a single case which impressed me strongly, and which has made me realize that the method has definite value. It was doubly impressive, for the patient was a doctor's secretary and a friend of all connected with the handling of her case. She was 53 years of age and had had one child at the age of 36. She consulted a gynecologist in December, 1947, because of slight vaginal bleeding. As she had had estrogen, testosterone was given and the bleeding stopped. One year later bleeding recurred following estrogen and again stopped after testosterone.



Fig. 1. Photograph of cervix; apparently normal.

The cervix was apparently normal (fig. 1), with no suggestion of erosion or scarring. There was no area which could be selected for biopsy. Smears were made from the cervical os and the vaginal vault. On examination of these smears, in addition to perfectly normal squamous cells, occasional cells slightly larger and less differentiated were found. Many of these suggested atypical cells of the basal type. Perhaps the diagnosis should have been made at this point, but whenever the patient is a member of the family or a friend, there always creeps in a "can't happen here" attitude. So additional smears were requested and these showed rather conclu-

sive evidence of malignancy (figs. 2 and 3), with single tumor cells and also small cell masses. Scrapings from the endocervix and canal

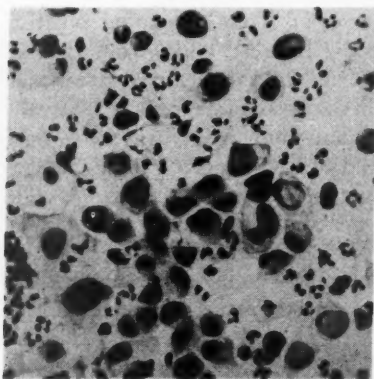


Fig. 2. Cervical smear stained by Papanicolaou technic (300x).

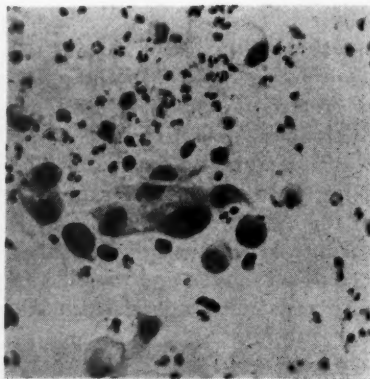


Fig. 3. Cervical smear stained by Papanicolaou technic (300x).

were then requested and this material was fixed, embedded and sectioned and the diagnosis definitely proved (fig. 4).

The patient received radiation by means of intracavity radium

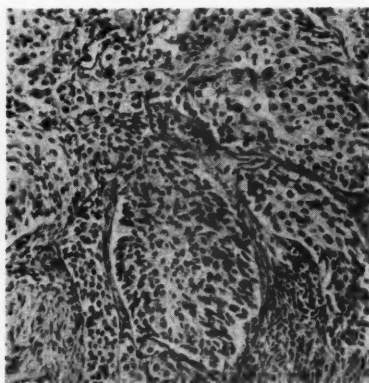


Fig. 4. Biopsy from within cervical canal, H & E stain (100x).

and external deep therapy, followed by hysterectomy. The uterus showed the tumor in the upper cervical canal, but what was most surprising, in view of the absence of symptoms and signs, the tumor had invaded the uterine wall to within a hair's breadth of the outer surface. However, no evidence of extension beyond the uterus was

found. Here, then, was a patient with few and very vague and somewhat misleading symptoms, and without any visible evidence of disease, yet she had advanced carcinoma.

The preliminary diagnosis of cancer by means of smears is here to stay and is meeting with increasing favor. Its value may be even greater in the coming years. However, early enthusiasm should be and has been tempered with caution and conservatism.¹⁴ The technic and ability to make such diagnoses requires long and increasing experience, with abundant material, unlimited time, infinite patience, and complete cooperation and understanding between surgeon and pathologist.

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THE WASHINGTON MEETING

Congratulations and sincere thanks to our members in the District of Columbia and Maryland! The newest additions to The Southeastern Surgical Congress proved themselves hosts of the first rank at our recent gathering in Washington. In every respect, it was a meeting *par excellence*, the entire four days being filled to the brim with interesting events. The keynote of the meeting, sounded by Dr. Harry Lee Claud in his welcoming address, was "The American Way." He truly stated, "A single motive unites this Assembly into a closely knit brotherhood. We are here to share in each other's experiences, so that we may better serve our fellow men. That is the American Way." Dr. Claud, who was Chairman of the Committee on Arrangements, then asked us to make Washington our home, and not one of those present could have been more graciously received in his own home. The Shoreham Hotel, our headquarters, was a superb meeting place, and nothing was left undone for our comfort and convenience. The entertainment was delightful, adding immeasurably to our enjoyment.

The forty-one scientific papers on the program were of surpassing merit and were sufficiently diverse in subject-matter to hold something of prime importance to all. The papers presented on the first day were devoted to urologic diseases, those on the second day to a miscellaneous group of subjects, on the third day to gynecologic

and other disorders, and on the fourth day to gastrointestinal diseases.

The scientific exhibits also were well planned and most instructive, and the technical exhibits were of the best.

Dr. Wilkinson's Presidential Address was a highlight of the meeting and a master stroke at this particular time, dealing as it did with the effects of medical education upon our economic future. He reminded us that, in the pursuit of scientific knowledge, economic problems have largely been overlooked by the profession, with the result that we are today being assailed by ruthless forces which have the welfare neither of the patient nor of the doctor at heart. He pointed out the need for a comprehensive program, actively supported by every medical organization and every doctor, designed to correct the ills which so vitally affect both the profession and the lay public. He recommended that dentistry, pharmacy, nursing and hospitals be included in such a program, since these, also, are susceptible to the destructive influences which threaten our profession.

President Wilkinson deplored, first, the current practice of educating medical students to be specialists, and stressed the need for more physicians trained in general practice as a method of reducing the cost of medical care. He reminded us of the need for a better distribution of doctors, as well as for more graduates each year in order to meet the demands, not only of a heavily increased population, but also of Veterans' Hospitals and peace-time military forces. In this connection, he brought out the startling fact that only about 20 per cent of the patients in our Veterans' Hospitals are under treatment for service-connected disabilities; the remaining 80 per cent are being treated for disabilities which have no relation to military service. Not only does this result in a shortage of doctors in private practice, but it places the Veterans' Hospitals in competition with non-veteran institutions. Further, it adds tremendously to the taxpayers' burdens. President Wilkinson also added his voice to the general cry against the practice of medicine by hospitals. Finally, he outlined a plan whereby good medical treatment for all the people could be provided at a cost commensurate with their financial ability.

Along the same line, Dr. Elmer Hess, Vice-Chairman of the Council on Medical Service for the American Medical Association, elaborated upon the relations of the medical profession and the hospitals, and offered suggestions for the solution of their mutual problems.

One heard on every hand expressions of commendation of Dr.

Wilkinson and Dr. Hess on these addresses. If more of our profession were to tackle these problems with the same force, they would soon be solved to the satisfaction of every group concerned.

Pursuing the general theme of economic reform, a group of resolutions was offered by a duly appointed committee and unanimously passed. These resolutions included (1) opposition of The Southeastern Surgical Congress to the socialization of medicine in any form; (2) approval of voluntary health insurance for all, predicated on local or state control; (3) opposition to the direct practice of medicine by hospitals; (4) cooperation with the American Medical Association in insuring the best of medical and surgical care of veterans with service connected disabilities, but discouraging such care of veterans with non-service connected disabilities in Federal hospitals; (5) endorsement of the stand of the Southern Medical Association on its study of medical education; (6) recognition of the need for more adequate education and training facilities for negro physicians; and (7) inclusion of dentistry, pharmacy, nursing and allied fields in a study of medical education.

The Convocation Exercise, presided over by Vice-President Joseph S. Stewart, of Miami, was a brilliant event. The candidates were presented by Secretary Beasley, and the fellowships were conferred by President Wilkinson. One hundred twenty-seven new members, forty-five of whom were from the District of Columbia and Maryland, were welcomed into the Congress. Dr. George F. Lull, Secretary and General Manager of the American Medical Association, delivered the Convocation Address, speaking in a thought-provoking manner on "The Doctor's Responsibility in View of the Changing Times."

At the close of the scientific sessions, Dr. C. C. Howard, of Glasgow, Ky., was installed as President for the ensuing year, Dr. J. S. Stewart, of Miami, was made President-Elect, and Dr. J. Duffy Hancock, of Louisville, was elected Vice-President. The appointment of Dr. B. T. Beasley as Secretary-Treasurer was reaffirmed. An invitation to hold the nineteenth gathering of the Congress at the Hollywood Hotel, Hollywood, Fla., was accepted. It was agreed that the meeting would be held early in April, 1951.

In retrospect, it is not too much to say that the Washington meeting was one of the most successful in the annals of our Congress. Every one had a fine time, enjoying the fun and fellowship to the utmost, and profiting immeasurably from the scientific presentations. Aside from these features, a strong spirit of militancy permeated the atmosphere—militancy for the preservation of the ideals of our profession with, at the same time, a profound regard

for the medical needs of the public. One might say that the entire Congress girded itself for the battle. It is fervently hoped that every member will keep this spirit alive and active by doing his part to bring to a victorious conclusion our crusade against those forces in our Federal Government which have as their objective the subversion, not only of the medical profession and its branches, but of every other phase of our national freedom.

R. L. SANDERS, M.D.

BOOK REVIEWS

The Editors of THE SOUTHERN SURGEON will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The editors do not, however, agree to review all books that have been submitted without solicitation.

PRINCIPLES AND PRACTICE OF PLASTIC SURGERY. By Arthur Joseph Barsky, M.D., D.D.S. 499 pages. Price, \$10. Baltimore, Maryland: The Williams & Wilkins Co., 1949.

Dr. Barsky is a well recognized plastic surgeon whose experience includes both the wartime experience of World War II and the civilian practice of the specialty in New York.

The book is well constructed, printed on fine glossy paper, and measures 6¾ by 10 inches. There are 499 pages and numerous drawings and photographs. The first six chapters deal with the fundamental principles of plastic surgery while the remainder describe the practice of the specialty.

The subject-matter is clear and to the point, the author stressing in each case the procedures by which he obtains the best results. It should serve more as a handy reference than as a complete reference book, but is authoritative and notable for its broad coverage of the subject of plastic surgery. It is easy to read and to understand.

The illustrations, both photographs and drawings, are clear and easily understood. They are adequate in number to facilitate the reader's ready understanding of a particular procedure.

Though primarily of value and interest to the plastic surgeon, it should find a welcome place in the library of the general surgeon and the surgical resident who have an interest in plastic surgery but who do not wish to be confused by a multiplicity of procedures.

J. R. L.

PRACTICAL NEUROLOGICAL DIAGNOSIS. R. Glenn Spurling, M.D., Clinical Professor of Surgery, University of Louisville, School of Medicine, Louisville, Kentucky. Fourth Edition, 237 pages, with 119 illustrations. Price, \$——. Charles C Thomas, Publisher, 1950. Springfield, Illinois.

This volume begins with a glossary of terms used by the neurologist and the neurosurgeon, and then takes up in detail the neurologic examination, each aspect being carefully described and the underlying theory explained. The printing is good, the paper excellent, the drawings and photographs are also very good and clearly describe the wishes of the author.

The book is arranged in a sensible manner describing the history taking and general considerations first, followed by the cranial nerves, the cerebrum, the cerebellum, the spinal cord, the reflexes, the cerebrospinal fluid, and finally the roentgenologic diagnosis.

This book should find a place in the library of all hospitals which have a teaching program for the use of the internes and residents; likewise, it should be of use to all general surgeons who, as well as internists, are faced with neurologic problems on occasions. The book is well written.

This being the fourth edition, it varies from the other editions by the se-

quence of the subject-matter being somewhat altered. The chapter on the cerebellum has been completely rewritten, and a section on hypothalamus added, the glossary has also been added. The author apparently has fulfilled his original objective, "To present a simple account of the principles of neurologic diagnosis—for students and practitioners who desire more proficiency in the recognition of neurological disorders."

A. H. LETTON, M.D.

LORD LISTER—HIS LIFE AND DOCTRINE. By Douglas Guthrie. 128 pages. Price, \$3.50. The Williams and Wilkins Company, Baltimore, Maryland.

Here is a volume that belongs in the library of every surgeon. It is the presentation of the life, beliefs, the actions of Joseph Lister, who 84 years ago made the discovery which was destined to revolutionize surgery, to save lives, and to relieve untold suffering. The volume is written in a straightforward, professional manner and is not the romantic presentation of one of the greater stories of surgery. It begins of telling what we owe to Lister, showing the contrast of the two periods, before and after Lister. Two quotations in particular are striking, one taken from James Spense, professor of surgery in Edinburgh in 1864, in which he said, speaking of wounds, "The edges made here can become incorporated, but this is rare, except in the most trifling incisions." The next quotation taken from the recent work of Professor Illingworth, 1938, the present occupant of Lister's chair of Glasgow. He states, "If the margins of a clean incised wound are accurately co-apted, healing takes place with little disturbance." The author proceeds with his story telling of excerpts from different men's lives, he quotes them and tells of their discoveries, all leading up to and describing surgery before Lister. Then he begins with the life of Lister himself, describes his home life and young boyhood days, his student days, and showing how even in his early days, because of inspiration by his father, he published papers in the leading medical magazines. One of these was "On the Contractile Tissue of the Iris," and the other, "The Muscular Tissue of the Skin." An outline is given of the Edinburgh school of surgery and of Lister's professors and chiefs, as well as a description of the Royal College of Surgeons of Edinburgh. The author then describes James Syme, who had such a great influence on the young man.

A description of the thoughts of Lister concerning the laudable pus and the infections of all surgery of that day is next presented, with the clue being given in the lecture by Lister in 1868, "The germ of putrefaction, is the pole star which will guide you safely through what would otherwise be a navigation of hopeless difficulty." On another occasion he said, "You must be able to see with your mental eye the septic fragments as distinctly as you see flies and other insects with the corporeal eye. If you can, you will be properly on your guard against them." It is to be remembered at this time neither Lister nor anyone else had ever seen the micro-organism which caused suppuration and that all efforts to combat decomposition of the blood in open wounds were still in vain until Pasteur's researches opened the new way by combating the microbes. Lister tried many chemicals and finally started carbolic acid, which was at that time a sticky malodorous liquid known as German cresol. Soon he obtained from Frederick Calvert a purer substance which was less irritating and caustic. This he began using in the dressing of wounds, which, surprisingly enough, was quick to bring a reprisal from his contemporaries. It was the use, or rather the misuse, of the word "antiseptic" which misled most of his critics. In March of 1865, the first case was treated and proved a failure.

As Lister modestly states, "due to improper management," but this did not stop his investigation and soon another case became available. This was an eleven year old boy, with a compound fracture of the left leg. Undiluted carbolic acid was applied to all parts of the wound. It was then covered with lint or calico soaked in the same fluid. The wound healed per primum.

The description of the introduction of catgut by Lister is most interesting. It describes his experiment of putting it into the neck of a calf, which was later killed and the specimen removed showing the complete absorption of the catgut. The rest of the book deals with the struggles of Lister as he climbed against the opposition of antiseptic surgery and finally how he was acknowledged as one of medicine's great men. He was feted throughout the world for his discovery and service to mankind, but in all Joseph Lister was a modest man. On one of his visits to Canada, as described by Sir Michael Foster, an eminent physiologist, "In early life Lord Lister belonged to a society, the members of which called all men 'friends,' and now in turn, because of his inestimable beneficence and service to mankind, all men the world over call him 'friend'."

The last years of his life were fairly quiet and as his weakness increased, he passed from this life very quietly on the 10th day of February, 1912.

"SUCCESS DEPENDS UPON ATTENTION TO DETAIL."—*Lister*.

A. H. LETTON, M.D.

ABSTRACTS FROM CURRENT LITERATURE

CRITICAL EVALUATION OF SYMPATHECTOMY IN PERIPHERAL VASCULAR DISEASE. M. DeBakey and A. Ochsner. Wisconsin M. J. 48:666-698-765 (Aug.) 1949.

On the basis of wide personal experience and a complete review of the literature, the authors present a critical discussion of the application of sympathectomy in the treatment of peripheral vascular disease. A lucid presentation of the rationale of the principle is followed by detailed discussion of the indications of the operations not only in peripheral arteriosclerosis and thromboangiitis obliterans but in the less frequent vascular disturbances including arterial catastrophe following injury, embolism or ligation; venous thrombosis; Reynaud's phenomenon; causalgia; etc. The various limitations of sympathectomy are carefully evaluated. "It is evident that the benefits of sympathectomy in peripheral vascular disturbances may be modified or limited to a varying degree by a number of factors, including the variable pathological process, local vascular faults, development of intrinsic vascular tone, humoral influences, regeneration, and incomplete denervation and readjustment of sympathectomy activity through residual nerve pathways. It is important to recognize these possible limiting factors and to appreciate their significance in the performance of sympathectomy. It is equally important, however, to recognize that they do not contraindicate the procedure or even greatly restrict its application."

MASSIVE PULMONARY COLLAPSE FOLLOWING ANESTHESIA WITH CURARE. R. Foregger, H. Rettig, and Conde Conroy, Wisconsin M. J. 45:1004-1006 (Nov.) 1949.

Since its introduction into the practice of anesthesia in 1942, curare has gained widespread use. Certain hazards exist in its administration, as with any other drug, and discretion must be used. The authors report the case of a 58 year old woman weighing 220 pounds suffering from intestinal obstruction in whom was induced with cyclopropane and ether and maintained with cyclopropane through an endotracheal tube. Shortly after the operation was commenced, the patient was given 3 c.c. of intocostarin. Respirations ceased within three minutes but the patient's condition remained good with artificial ventilation. The condition still seemed good when the operation (lasting one hour and a half) was completed. At that time prostigmine was administered. During the next two hours all the usual procedures were carried out, in an effort to reestablish respiration, without effect. About seven hours after anesthesia was begun, the circulation began to fail and the patient died about 8½ hours after anesthesia was begun.

Autopsy revealed massive bilateral pulmonary atelectasis. The examination of the brain revealed no abnormalities.

The authors feel that death was in some manner connected with the administration of curare. Mechanisms discussed as possible explanations include the unlikely possibility that the patient had subclinical myasthenia gravis, prolonged use of high concentration of oxygen which is known to result in atelectasis in certain susceptible individuals, rupture of an emphysematous patch by too vigorous artificial respiration (the autopsy findings would seem to exclude this possibility) and production of bronchoconstriction by the curare

(this theory is strengthened by the fact that the lungs could be inflated with ease after death whereas prior to death, pulmonary inflation had been extremely difficult).

The authors conclude that the sequence of events was most probably attributable to curare.

NEUROGENIC DISEASE OF THE BLADDER: THE SURGICAL MANAGEMENT OF ITS COMPLICATIONS. J. H. Semans, *J. Urol.* 62:820-832 (Dec.) 1949.

Improvement in the treatment and management of patients with spinal cord lesions and the increasing survival in these patients has resulted in an increase in the frequency with which the urologist must deal with neurogenic disease of the bladder. While neurogenic and neurologic bladder are synonymous terms, the term cord bladder is reserved for dysfunction resulting from lesions confined to the spinal cord. The level of the injury is of utmost importance in predicting the exact dysfunction which will result and this can be done with a fair degree of accuracy if all the tracts of the cord are severed at a certain level. This is rarely the case since most lesions are incomplete.

Lesions high in the cord (above the twelfth dermatome) will probably result in a completely automatic bladder which is highly efficient. Lesions below this level may interfere totally or partially with the reflex neural pathway and result in a weakening of the detrusor. In this instance, the bladder may not be expected to empty itself reflexly and, due to a lack of integration in the contractions of the fibers of the detrusor, retention and overflow incontinence may be expected. Occasionally, a low lesion will result in a bladder of very small capacity and with urinary leakage.

The permanence of such lesions is more uncertain than might be presumed. Failure of return of function after a year, particularly if decompression of the cord has been instituted is satisfactory evidence of permanence.

The various methods of treatment and management which have been generally employed are discussed and evaluated by the author. These include suprapubic cystostomy, intermittent irrigation, unilateral and bilateral pudendal neurectomy, presacral ganglionectomy and membranous urethrorrhisis and urethroplasty (which the author has employed in 17 cases). The latter procedure is not advocated unless other procedures have failed because postoperative incontinence occurs in some cases. Transurethral resection of the vesicle neck and prostate gland has been employed more recently with excellent results. Repeated resection may be necessary.

In all cases, spontaneous recovery of function is to be hoped for and looked for. Suprapubic cystostomy is indicated for management when continuous or intermittent urethral drainage is impractical. "The ultimate aim in treatment of the neurogenic bladder is the voiding of minimally infected urine without leakage or retention."

THYROIDITIS. W. H. Kisner; J. Reganis, and D. Haughton, *New Orleans M. & S. J.* 102:217-222 (Nov.) 1949.

In the opinion of the authors, acute and chronic thyroiditis is encountered more frequently in the Gulf States in comparison to the relatively small number of goiters than is reported from other sections of the country. An orderly discussion of the incidence, pathology, symptomatology, diagnosis and treatment of these diseases is presented.

In a study of 172 consecutive thyroidectomies from the Mahorner Surgical group at the Touro Infirmary and the Southern Baptist Hospital (New Orleans), the incidence of chronic thyroiditis was 4.06 per cent. Of the seven cases, four were Hashimoto's disease, two were Reidel's struma and one was classified as nonspecific chronic thyroiditis. In a study of all thyroid specimens removed surgically at these hospitals an incidence of 8.11 per cent was noted. Of these eighteen cases, nine were Hashimoto's disease, three were Reidel's struma and six were classified as nonspecific.

Though the authors have no figures for comparison, they feel that acute thyroiditis is also more common in the Gulf States than in other parts of the United States.

TESTICULAR TUMORS: LATE RESULTS OF RADICAL SURGERY. A. W. Adams, Brit. J. Urol. 21:329-333 (Dec.) 1949.

This paper is a postscript to the author's original communication on this subject (1940). The late results in five cases of testicular seminoma treated by radical orchiectomy provide the basis for this latest report. All of these patients are well, actively engaged in work, and are free of symptoms of recurrence from eleven to fourteen years after operation. In the original communication, it was reported that three of the eight original patients died within a year or two of operation. The author now feels that though they were too far advanced to hope for more than palliation, they might have done better with concomitant radiation. The author feels that radical orchiectomy with en bloc dissection of the solitary pathway to the distant lumbar glands is the method of choice in dealing with these malignancies.

In addition, two cases are presented for their interest in differential diagnosis. One is a case of fibroid epididymitis and the other an obscure testicular cancer.

THE FATE OF THE FORESKIN. *A Study of Circumcision.* D. Gairdner, Brit. M. J. 1433-1437 (Dec. 24) 1949.

The author, who is Consultant Pediatrician to the United Cambridge (England) Hospitals, in noting that about sixteen children die in England each year as a result of circumcision, has attempted to marshall the facts concerning the advisability of infant circumcision. Noting that the practice, often associated with analogous sexual mutilation of females, is fairly general throughout the eastern hemisphere, it is largely confined to the English-speaking peoples in the western hemisphere. A discussion of the origin of circumcision is followed by a presentation of the embryology and anatomy of the prepuce. In discussing the development of the structure it is emphasized that it serves a definite function of protection of the glans during the stage when the child is incontinent. Meatal ulcer is confined to the circumcized infant and is due to contact of the exposed glans with sodden diapers. It is pointed out that true phimosis is extremely rare in the child under one year of age. The prepuce is not normally retractable at this age due to incomplete separation of the layers.

The author enters into a thorough critical review of the various indications for circumcision in the infant and of the usual reasons offered for doing the operation on the infant. He is able to refute most of these. It seems fairly certain that circumcision before the age of five years will prevent the development of penile cancer in later life. Since this condition is so frequently asso-

ciated with filth and largely occurs in men of low intelligence, it would seem to follow that the uncircumcised male who has a retractable foreskin which he keeps clean is likely to enjoy the same immunity to penile cancer as his circumcised brother. The question of the relationship of cervical cancer and the presence or absence of the foreskin in the spouse must be clarified by further investigation.

In the light of these facts, a conservative attitude towards the prepuce is proposed, and a routine for its hygiene is suggested. The adoption of the proposed policy would eliminate the vast majority of the tens of thousands of circumcisions performed in England each year along with the yearly toll of some sixteen child deaths.

THE DIFFICULT GENITAL FISTULA; TEMPORARY DECENSUS UTERI FOR RELIEF OF TENSION. G. A. Williams, *Am. J. Obst. & Gynec.* 58:1066-1072 (Dec.) 1949.

In presenting a general discussion of the various principles and methods employed in the management of difficult and complicated vesicovaginal, rectovaginal and combined fistulae, the author presents a new method for relieving the tension on the suture line in surgical repair of such a fistula. Faced with the problem of a transverse closure in a vesicourethrovaginal fistula which would not tolerate the tension which occurred when the cervix was released, the author drew the cervix down again and fixed it in a position of decensus with a suture brought over the fourchette and anchored to the deep fascia over the ischiopubic rami. This was released on the eighth day (which the author considered to be a little early) and an excellent result was obtained. In the future he plans to devise a means of anchoring the suture so that it may be released gradually to prevent the risk of wound disruption which could result from sudden release. In discussion, Dr. Waverly R. Payne suggests that the sutures might be anchored to an external perineal band such as a metal catheter holder.

Other methods usually employed in the management of the various types of genital fistulae are presented.

LIGATION OF THE VENA CAVA AND OVARIAN VESSELS. *A Follow-Up Study of Fifty-Nine Cases.* C. G. Collins; E. W. Nelson; C. T. Ray; B. B. Weinstein, and J. H. Collins, *Am. J. Obst. & Gynec.* 58:1155-1168 (Dec.) 1949.

Since one of the authors first employed ligation of the inferior vena cava and ovarian vessels for the treatment of suppurative pelvic thrombophlebitis in 1942, 59 consecutive cases have been so treated and observed. These provide the basis for this report. The following indications are restated:

"1) Patients with suppurative pelvic thrombophlebitis who fail to improve after four or five days of medical regimen (blood chemotherapy, antibiotics).

"2) Patients with suppurative pelvic thrombophlebitis, receiving nonsurgical treatment, in whom pulmonary infarction develops irrespective of the duration of medical regimen.

"3) Patients with suppurative pelvic thrombophlebitis and evidence of infarction on admission. Operation is performed on these patients *immediately*.

"4) Patients with large pelvic tumors complicated by phlebothrombosis, thrombophlebitis, or both, involving the iliac vessels."

The transperitoneal approach is recommended for thrombophlebitis except when it follows hysterectomy or other pelvic procedure in which the ovarian vessels have already been ligated. The same approach is recommended in both sexes for the treatment of phlebothrombosis involving the common femoral vein or veins (or higher).

Of the 59 patients, 52 survived and 7 (12 per cent) died. The diagnosis was substantiated by either operation or autopsy in all of the patients who died. All of the patients who died within one year were considered to be operative failures. In only one case might the procedure itself be blamed for fatality. In this patient who died immediately following operation, the pathologic condition noted at operation and at autopsy makes this questionable.

Immediately following operation, mild edema of the feet and ankles is noted in the majority of cases. This usually disappears in a few weeks or months. In nearly all cases the right or left or both sympathetic chains were interrupted and postoperative lumbar block was done on the uninterrupted side. The authors feel that this procedure greatly diminishes morbidity. To date nine patients still have edema which is mild in all but one patient who had recurrent phlebitis and edema of eleven years' duration. Investigation of the post-operative vascular status by various methods including the measurement of the venous pressure seems to indicate that there is adequate compensation for vena cava ligation.

Observations by various methods of the ovulatory status and the frequent occurrence of pregnancy with successful delivery of a term infant would seem to indicate that in most cases ligation of the inferior vena cava and the ovarian vessels does not seriously interfere with ovulatory function. Sexual function is not altered.

In discussion, Dr. Ralph A. Reis of Chicago and Dr. Joe V. Meigs of Boston stated their belief that the safety and efficacy of the procedure is now established but that the need for widespread application as advised by the authors is not proved. Dr. T. K. Brown of St. Louis seemed to be slightly more inclined to widespread application.

GASTRIC AND DUODENAL ULCERS AND THEIR COMPLICATIONS. *Treatment by Extensive Resection.* H. Finsterer, J. Internat. Coll. Surgeons 12:599-624 (Sept.-Oct.) 1949.

The author first advocated extensive resection of at least one-half and up to two-thirds of the stomach as the treatment of choice in peptic ulcer over 30 years ago. His observation that this operation was followed by anacidity (which he considered at that time to be detrimental) led to his abandonment of the procedure for a short time and to return to gastroenterostomy of less extensive (antral) resection. Following the establishment of the transient nature of the anacidity and the realization of the true significance of this phenomenon, he returned to this procedure which he has seen come into general use. His extremely wide experience with this procedure forms the basis of this reports.

Interspersed in a general discussion of the subject in which the history of the surgical treatment of ulcer is thoroughly covered, he reiterates certain principles which he considers to be of utmost importance. His method of

closing the duodenal stump with a purse string suture reinforced with Lembert sutures is again described in detail. He restated his conviction that local anesthesia of the abdominal wall plus splanchnic block is the anesthesia of choice.

The summary is quoted:

"The *extensive two-thirds resection* suggested by the author thirty years ago in the treatment of gastric and duodenal ulcer has been applied in the author's ward, as well as in various private hospitals, in 8,230 cases. The *mortality* for resection of uncomplicated gastric or duodenal ulcer was 2.6 per cent (2,191 resections with 58 deaths) in private hospitals. On the ward of the Allgemeines Krankenhaus, between 1935 and 1947, it was 3.9 per cent (4,191 resections with 180 deaths). In *resection for exclusion* in 119 cases where the pylorus had been left untouched, five deaths resulted, whereas 13.7 per cent mortality was observed when the pylorus also had been removed. Out of the 614 patients with *ulcer near the cardia*, 48 died; the *arch-shaped resection* had a 10.3 per cent mortality where the ulcer had penetrated into the pancreas (426 resections with 44 deaths). Out of 109 patients whose ulcers had not penetrated, all were cured after an arch-shaped resection and a Billroth I anastomosis. Of 79 operated on by the method of Madlener, four died.

"In cases of *acute profuse hemorrhage* the resection as an *early operation* met with 3.6 per cent mortality (165 resections with six deaths). The *late operation* was followed by 31 deaths in 136 resections (22.8 per cent) mainly because of parenchymatous degeneration of the organs due to anemia. As for the *acute perforation* of an ulcer, in 90 resections four patients died (4.4 per cent); there was a 25 per cent mortality in 208 ruptures covered by stitches. *Radical operation for peptic jejunal ulcer* showed 11.9 per cent mortality in 293 uncomplicated cases, whereas in 49 cases complicated hemorrhage or a colon fistula the mortality was 40.8 per cent.

"The *permanent results* were very good after extensive resection. A control check-up in 1933 revealed 234 of 244 gastric ulcer patients to be completely free of pain (95.8 per cent). Ten suffered with minor pains (4.4 per cent) and none was uncured. For *duodenal ulcer*, of 508 resected patients, 481 (94.6 per cent) were absolutely cured after six to twenty-one years. Ten were improved and seventeen (3.3 per cent) were uncured. The *frequency of peptic jejunal ulcer*, indicated by Starlinger to be 0.6 per cent, was 0.03 per cent only (5,942 resections according to the Hofmeister-Finsterer method, with two peptic ulcers of the jejunum reoperated on by the author himself).

"In *resection for exclusion* without pylorotomy, 78 of 90 patients were completely cured, two were improved and uncured, among whom there were five gastro-jejunal ulcers (all operated on prior to 1926). In resection for exclusion with pylorotomy, of 35 patients 27 remained cured, four were improved and four were uncured.

"In the *radical operation for gastrojejunal ulcers* the best permanent results were obtained by the extensive resection and Hofmeister-Finsterer anastomosis. Of 55 patients, 50 were completely cured, five improved and none uncured. The *poorest results* were observed from *resection with a Y-shaped anastomosis*. Of 21 patients only seven were cured, one was improved and 13 remained uncured. Only a *subtotal resection* with *permanent acidity* established will yield permanent cures and may do so even with a Y-shaped anastomosis. Two brothers are cited, who remained absolutely pain-free after subtotal resection for recurrent gastrojejunal ulcer, despite a renewed Y-shaped anastomosis, for 17 and 27 years respectively.

"The ulcer which seems to be *surgically incurable* and which recurs despite several operations *may be avoided* by a renewed operation which eliminates the reasons for the repeated recurrences. They are: (1) a *Y-shaped anastomosis*; (2) an *entero-anastomosis* added to the ordinary end-to-side anastomosis; and (3) *too small a stomach resection*. Thus the patients may be permanently cured, 18 had remained absolutely pain-free for four to eighteen years.

"It is to be decided by further observation whether or not the vagus resection suggested by Dragstedt yields the same good permanent results that are achieved by extensive stomach resection."

A SIMPLE METHOD OF DETERMINING BLOOD LOSS. T. Harrison and P. W. Harrison, South. M. J. 43:46-48 (Jan.) 1950.

The authors, who feel that Wangenstein's very accurate but technical and time-consuming method was impractical in all except the largest clinics, have devised a much simpler method for estimating blood loss during operation. This method requires no special equipment and has the advantage of being applicable where saline-moistened sponges are used. Any standard colorimeter may be used.

As soon as feasible following operation (no appreciable error is incurred by allowing the sponges, etc., to wait up to 3 hours before being washed) all sponges, towels, etc., containing blood are rinsed in a measured volume (about 200 times the gross estimate of the amount of hemorrhage) of 0.1 per cent sodium carbonate solution. The hemoglobin of this wash is then estimated by the following equation:

$$\frac{(\text{Hgb. percentage of wash solution}) (\text{c.c. of wash solution})}{(\text{Hgb. of patient's blood}) (200 \text{ c.c.})} = \text{c.c. blood loss}$$

The patient's hemoglobin is measured immediately before operation.

The chief difficulty with the method is in estimating the amount of blood loss with sufficient accuracy to arrive with reasonable margin of error at the correct volume of wash solution. Errors up to 2.8 per cent are reached as the figure departs more and more from the ideal of 1/200. In tests using measured volumes of blood, dilutions were used from 1/130 to 1/310. The authors feel that error under 3 per cent is negligible for ordinary purposes.

In operations where the blood loss runs to several hundred c.c., it is easier to use a smaller volume for the initial wash and bring this up to the correct volume by dilution.

The writers have found that the measurement of blood loss is a great encouragement of careful hemostasis.

SPLANCHNIC NERVE SECTION FOR PANCREATIC PAIN. *Second Report.* G. de Takats; L. E. Walter, and J. Lasner, Ann. Surg. 131:44-57 (Jan.) 1950.

Since the publication of an earlier communication on this subject in 1947, the authors have had additional experience with the employment of splanchnic nerve section for the relief of intractable pancreatic pain. Seven cases (including two cases previously reported) are included in this report. The authors now feel that this procedure is not indicated for the relief of pancreatic pain due to malignancy of the pancreas as the relief in such instances is only tem-

porary. Its chief value seems to be for the relief of pain due to chronic sclerosing pancreatitis. In one of the five new cases reported the diagnosis of malignancy was doubtful on the first exploration and the true diagnosis was not apparent until after the sympathectomy had been performed. The remaining patients suffered from chronic calcareous pancreatitis and all obtained excellent relief from pain following the procedure. The procedure employed was a retropleural supradiaphragmatic section of the splanchnic nerve and excision of the dorsal sympathetic chain from the ninth to the twelfth dorsal segments.

Two out of the four patients successfully treated had bilateral splanchnicectomies and the authors feel that a certain group of patients whose pain is diffuse should have the second splanchnic cut after the pain subsides and shifts from the dominant to the silent side. They also feel that the state of the biliary tract should be considered and drainage is possibly indicated in certain cases as biliary reflux into the pancreatic ducts may occur under certain conditions.

THE ANATOMY OF THE HERNIAL REGIONS. III. *Obturator Hernia and General Considerations.* B. J. Anson; L. J. McCormack, and H. C. Cleveland, Surg., Gynec. & Obst. 90:31-38 (Jan.) 1950.

In this, the last of three communications on the subject of the anatomy of the hernial regions, the authors present a detailed description of the region of the obturator canal with the usual excellent illustrations and in addition offer some observations on the subject in general. The conclusions are quoted:

"Medial femoral and parietal pelvic muscles, together with strong ligaments, guard the osseomembranous obturator canal. The canal, itself oblique, ends externally at the superior border of the thick obturator externus muscle. The upper border of the latter muscle occupies an oblique sulcus. The sulcus is produced by the aponeurosis of the adductor brevis. The aponeurosis is attached to the outer crest of the obturator canal and extends laterally to the capsule of the hip joint. The canal is small, transmitting lesser nerves and vessels; it constitutes a minor fault in the pelvic portion of the abdominopelvic space. Internally the small orifice is buffered by a strong, relatively thickened preperitoneal connective tissue, and narrowed by the obturator internus muscle. Externally the orifice is equally small; it is not merely bordered by muscles, but is completely covered by them.

"Turning now from the anatomy of the obturator region in particular to a general comparison of the three hernial areas, it may be said that in the femoral region the structures which surround the femoral ring and canal do not constitute as effective a barricade against herniations as do the boundaries of the obturator canal. In the former region, the continuation of the iliac vessels enter the femoral triangle at the approximate middle of the line of fusion of pelvic and abdominal layers. Descending upon them in front is the innermost one of the three anterolateral abdominal layers, viz., the transverse abdominis; behind lies fascial investment (actually of aponeurotic nature) of the iliopsoas muscle. Converging upon the vessels, these conjoined fasciae form an outer femoral sheath. Within this coat lies the immediate packing for the vessels, the preperitoneal connective tissue, which is prolonged upon the artery and vein into the thigh, as an internal sheath. The "space" within the sheath is filled in approximately the lateral two-thirds by the femoral vessels, but is empty (save for areolar tissue and lymphatic elements) in its medial

one-third; the latter "space" is the ternal orifice (femoral ring) of the canal; only the thin preperitoneal layer intervenes. The latter relationship makes for weakness against herniation; however, strength is lent circumferentially by other anatomic structures, namely, a strong ligament (lucunar) medially, a taut ligament (inguinal) superiorly, a bone (pubis) inferiorly, and of vessels (femoral) laterally.

"Of the three sites on the inguinopelvic wall at which herniation may occur, the inguinal is least resistant. In descent of an indirect hernia, a funicular process is merely made more capacious, displacement of investing coats being possible on three of the four aspects. In succession, the abdominal orifice (or ring) is dilated, the inguinal opening is distended, and the space bounded by the crura at the subcutaneous ring is widened. Once the peritoneal diverticulum is occupied, further extension is not hindered by the presence of strongly resisting structures. When the hernia has reached a point midway between the rings, the overlying external oblique is represented by fascia bridging the gap between the aponeuritic crura; crura are displaceable and the fascia is extensible. Progress of the hernia therefore becomes easier as the mass advances toward the subcutaneous level. The investing internal oblique (cremaster layer) is regularly fascial and, therefore, is merely a thin, weak, intermediate covering. The funicular derivative of the transverse abdominal muscle is almost without exception purely fascial—usually so thin that the underlying fatty lobules in the preperitoneal layer can be seen clearly through it. Altogether then, the layers form lamellae of a five layered tube, through the innermost of which the hernial mass advances, expanding in succession, a serous layer (the processus vaginalis), a thin, areolar stratum, and three layers which are principally fascial in structure and which are locally anchored to bone only on the inferior aspect.

"In summarizing, then, it may be said that the fascial lining of the abdominopelvic cavity extends outward, as normal tubes at three points: anteriorly into the thigh as the femoral sheath; in the groin as the internal spermatic (infundibuliform) fascia; to the medial musculature of the thigh as the lining of the obturator canal. The inguinal canal contains the ducts of the testis with associated small visceral vessels and nerves, or, in the female, the round ligament of the uterus; the femoral transmits a pair of large vessels; the obturator carries small vessels and nerves, destined to supply musculature chiefly in the immediate area, viz., the proximal part of the adductor region. The preperitoneal tissue of the inguinal canal is areolar and fatty. Of the three, the inguinal is the least well guarded by musculature and skeletal structure; the obturator is the most effectively barricaded.

"Upon the basis of anatomical structure it would be expected that herniation would occur in the following order of frequency: inguinal, femoral and obturator . . . an order actually obtaining, as evidenced by laboratory and clinical experience."

RESOLUTION

Whereas, The Southeastern Surgical Congress, in annual assembly, having duly considered many factors influencing present and future medical care, herewith goes on record in regard to certain of these factors; therefore,

Resolved, That The Southeastern Surgical Congress heartily approves Voluntary Health Insurance for all, predicated on local or state control with interstate liaison.

Resolved, That The Southeastern Surgical Congress petition the American Medical Association to use its influence to ensure the finest possible medical and surgical care of veterans with service connected disabilities, regardless of cost.

Resolved, That the American Medical Association be requested to discourage medical care of non-service connected disabilities in Federal hospitals where it may interfere with adequate care of those with service connected disabilities but rather, if such care is necessary, that it be given on a local level with free choice of physician and hospital by the veteran concerned.

Resolved, That this Congress petition the American Medical Association to appoint a committee for a continuing study of the medical care of veterans.

Resolved, That The Southeastern Surgical Congress wholeheartedly endorse the stand of the Southern Medical Association on its study of medical education and proposes that the American Medical Association recognize the need for such a study, especially in the South.

Resolved, That The Southeastern Surgical Congress encourage more adequate education and training facilities for negro physicians.

Resolved, That any study of medical education include dentistry, pharmacy, nursing and all allied fields.

